

FORM PTO-1390		U.S. Department of Commerce Patent and Trademark Office		Attorney's Docket No.	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				2328-117	
INTERNATIONAL APPLICATION NO. PCT/FI98/00873		INTERNATIONAL FILING DATE 11 November 1998		U.S. Application No. (if known, see 37 CFR 1.5) 09/529967	
TITLE OF INVENTION TETRACYCLINE ASSAY METHOD					
APPLICANT(S) FOR DO/EO/US <u>Matti KORPELA, Matti KARP, and Jussi KURITTU</u>					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ul style="list-style-type: none"> a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) </p> <p>6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ul style="list-style-type: none"> a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. </p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>					
ITEMS 11. TO 16. below concern other document(s) or information included:					
<p>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information: Small Entity Statement</p>					

U.S. APPLICATION NO. (Check one, see 37 CFR 5.1) 09/529967		INTERNATIONAL APPLICATION NO PCT/FI/00873	ATTORNEY DOCKET NO. 2328-117
17. [X] The following fees are submitted. Basic National Fee (37 CFR 1.492)(a)(1)-(5): Search Report has been prepared by the EPO or JPO \$ 840.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$ 670.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$ 690.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$ 970.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$ 96.00		CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =		\$ 970.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		\$	
Claims	Number Filed	Number Extra	Rate
Total Claims	20 -20 =		X \$18.00
Independent Claims	3 - 3 =		X \$78.00
Multiple dependent claim(s) (if applicable)		+ \$260.00	\$
TOTAL OF ABOVE CALCULATIONS =		\$ 970.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).		\$ 485.00	
SUBTOTAL =		\$ 485.00	
Processing fee of \$130.00 for furnishing the English translation later [] 20 [] 30 than months from the earliest claimed priority date (37 CFR 1.492(f)).		\$	
TOTAL NATIONAL FEE =		\$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property		\$	
TOTAL FEES ENCLOSED =		\$ 485.00	
		Amount to be refunded	\$
		charged	\$
a. [XX] A check in the amount of \$ <u>485.00</u> to cover the above fees is enclosed.			
b. [] Please charge my Deposit Account No. 02-2135 in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.			
c. [XX] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2135. A duplicate copy of this sheet is enclosed.			
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.			
SEND ALL CORRESPONDENCE TO: Jeffrey L. Ihnen, Reg. No. 28,957 Rothwell, Figg, Ernst & Kurz 555 13th St., N.W. Washington, D.C. 20004 Phone: 202/783-6040		 JEFFREY L. IHNEN Name <u>28,957</u> Registration Number Dated: 24 April 2000	

09/529967

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of)
Matti KORPELA et al.) U.S. National Phase,
Serial No. (to be assigned)) PCT/FI98/00873
Filed: 24 April 2000) Intl. Filing Date:
For: TETRACYCLINE ASSAY METHOD) 11 November 1998

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of the above-identified U.S. National Phase of PCT/FI98/00873, filed concurrently herewith, please enter the following amendments thereto:

IN THE CLAIMS:

Please amend the claims as follows:

Claim 3, line 1, delete "or 2".

Claim 5, line 1, delete "or 2".

Claim 7, line 1, change "any of the claims 1-6" to -- claim 1 --.

Claim 8, line 1, change "any of the claims 1-6" to -- claim 1 --.

Claim 9, line 1, change "any of the claims 1-8" to -- claim 1 --.

Claim 10, line 1, change "any of the claims 1-9" to -- claim 1 --.

Claim 13, line 1, delete "or 12,".

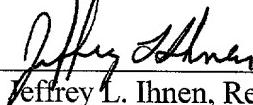
Please add the following new claims:

- 16. The method according to claim 2 characterized in that the DNA vector is a plasmid containing the luxCDABE genes (SEQ ID NO:3), tetracycline repressor (TetR) (SEQ ID NO:11) and tetracycline promotor (TetA) (SEQ ID NO:9) from *Tn*10. --
- 17. The method according to claim 16 characterized in that the DNA vector is the plasmid pTetLux1 (SEQ ID NO:3). --
- 18. The method according to claim 2 characterized in that
- the DNA vector is a plasmid containing the insect luciferase gene (SEQ ID NO:1), tetracycline repressor (TetR) (SEQ ID NO:11) and tetracycline promoter (TetA) (SEQ ID NO:9) from *Tn*10, and that
- D-luciferin is added to the mixture of the sample and the cells in order to initiate the luminescence of the cells. --
- 19. The method according to claim 18 characterized in that the DNA vector is the plasmid pTetLuc1 (SEQ ID NO:1). --
- 20. The cell according to claim 12 characterized in that it is in dried form, e.g., in lyophilized form. --

REMARKS

The claims have been amended to delete multiple dependencies and to bring them more into conformance with U.S. practice. No new matter has been added by the above amendments, and their entry is therefore requested.

Respectfully submitted,

By 

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Dated: 24 April 2000

SMALL ENTITY DECLARATION

APPLICANT OR PATENTEE KORPELA, Matti, KARP, Matti and KURITTU, Jussi

SERIAL NO. _____ □ PATENT NO. _____ DOCKET NO. _____

(Check one

of blocks

1 or 2

1. FILED OR ISSUED _____

2. SUBMITTED HEREWITH _____

FOR "Tetracycline assay method"
(Insert Title)

I(we) hereby declare that I(we) am(are) entitled to the benefit of small entity status with respect to the above-identified application or patent for purposes of paying reduced fees under 35 USC 41(a) & (b) to the U.S. Patent and Trademark Office.

A. INDEPENDENT INVENTOR

I(we) qualify as (an) independent inventor(s) as defined in 37 CFR 1.9(c).

B. INDIVIDUAL NON-INVENTOR

I would qualify as an independent inventor as defined in 37 CFR 1.9(c) if I had made the invention.

C. SMALL BUSINESS CONCERN

I am THE OWNER AN OFFICIAL of the small business concern identified below and am empowered to act on behalf of the concern. The concern qualifies under 37 CFR 1.9(d) and 13 CFR 121.1301-1305. Rights under contract or law have been conveyed to and remain with the concern and are exclusive unless a checkmark is placed here . All other rights belong to small entities as defined in 37 CFR 1.9.

D. NON-PROFIT ORGANIZATION

I am an official am empowered to act on behalf of the non-profit organization identified below. The organization qualifies under 37 CFR 1.9(e), sub section: (1) (2) (3) (4). Rights under contract or law have been conveyed to and remain with the organization and are exclusive unless a checkmark is placed here . All other rights belong to small entities as defined in 37 CFR 1.9.

I(we) acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I(we) declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

A. INDEPENDENT INVENTOR(S)

KORPELA, Matti

Name

Signature

18.4.2000

Date

KARP, Matti

Name

Signature

17.4.2000

Date

KURITTU, Jussi

Name

Signature

19.4.2000

Date

Tetracycline assay method.

FIELD OF THE INVENTION

This invention relates to a method for the determination of a tetracycline in a sample. The invention also concerns recombinant prokaryotic cells capable of emitting light in response to the existence of a tetracycline in a sample. Furthermore, the invention relates to novel DNA vectors useful for the construction of said prokaryotic cells.

10 BACKGROUND OF THE INVENTION

The publications and other materials used herein to illuminate the background of the invention, and in particular, cases to provide additional details respecting the practice, are incorporated by reference.

15 Whole cells can be used in methods based on the use of living cells or organisms as sensor tools of detection. Many of these methods utilize bacterial or yeast cells. Prokaryotic organisms and especially *Escherichia coli* bacterium are very well characterized and maps of genes and their sequences at nucleotide level are known. Therefore the behavior of the whole cell sensor can be better understood. Because 20 of this fact it is also possible to develop analyte or group specific sensors utilizing different regulatory regions of genomes and also various microbial strains.

Whole cells can be utilized in biosensors which are devices consisting of 1) a sensor, 2) a recording unit and 3) a possible connector such as fiber optic guide 25 between 1 and 2. The recording unit has several choices of what is the physical background of the measurement. It can be change in heat, conductance, color reaction, changes in fluorescent properties, emission of endogenous light from the sensor cells etc.

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Antibiotics used as medicines against microbial invasion are detected from body fluids in order to study the dosage and penetration of the medicine. Often the effective therapeutic range of the antibiotic is rather narrow and the risks of overdosage might be too big. It is also important to measure the presence or concentration of antibiotics from meat and milk due to syndrome of allergic people.

In the course of cheese production milk used as starting material should not contain antibiotics due to the fact that cheesemaking bacteria are not able to work on contaminated milk.

10

Conventional tests for the measurement of toxic substances such as antimicrobial agents (antibiotics) are based on the inhibition of growth. Growth inhibition can be

agents (antibiotics) are based on the inhibition of growth. Growth inhibition can be followed by monitoring the zone where the growth of microbes is inhibited on a nutrient agar plate around a disk onto which an antibiotic dilution was pipetted.

15 Typical examples of agar diffusion tests are cylindrical, hole or disk methods. The difference in these tests is only restricted in the way the sample is applied on the agar and also the way the bacteria in the test is used. Another means is to follow the metabolism of the test organisms by estimating the intensity of a color reaction which is affected by the inhibitory antibiotic present and comparing it to the

20 uninhibited control (e.g. the commercial products: Delvo TestTM, Brilliant black-reduction test, Charm Farm Test, Charm AIM-96 and Valio T101-test). Since microbiological methods utilize bacteria or their spores it is the sensitivity of the test bacteria which is of utmost importance. Thus far one had to make compromises in the choice of a suitable test strain since great sensitivity against antimicrobial agents

25 and other characteristics needed for the test strain have not been common features for the same strain of bacteria. A major drawback when using microbes in antibiotic residue tests is slow and unsensitive performance. Since in these methods one always controls in a way or other the growth of the tester strain one cannot imagine

the test to be performed in an hour. This is due to the fact that the growth of the microbe is a slow phenomenon even at its fastest mode. Also in many cases microbes are in spores or freeze-dried, the regeneration of which makes the tests even more slow to perform.

5

OBJECT AND SUMMARY OF THE INVENTION

The object of the invention is to provide a novel method of determining a tetracycline in a sample where said method is rapid and selective for tetracyclines, i.e. the method is able to distinguish tetracyclines from other antimicrobial agents.

10

According to one aspect of the invention a method for the determination of a tetracycline in a sample is provided, wherein the method is characterized in that

- the sample is brought into contact with prokaryotic cells encompassing a DNA vector including a nucleotide sequence encoding a light producing enzyme under transcriptional control of a tetracycline repressor and a tetracycline promoter,
- detecting the luminescence emitted from the cells, and
- comparing the emitted luminescence to the luminescence emitted from cells in a control containing no tetracycline
- wherein a detectable luminescence higher than a luminescence of the control indicates the presence of tetracycline in the sample.

According to another aspect, the invention concerns a recombinant prokaryotic cell which encompasses a DNA vector including a nucleotide sequence encoding a light producing enzyme, tetracycline repressor and tetracycline promoter.

25

According to yet another aspect, the invention concerns a plasmid which comprises either

- the luxCDABE genes (SEQ ID NO: 3), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn*10, or
- the insect luciferase gene (SEQ ID NO: 1), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn*10.

5

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1a shows schematically the method according to this invention, where cells cloned with the plasmid pTetLux1 (SEQ ID NO: 3) are used.

- 10 Figure 1b shows schematically the method according to this invention, where cells cloned with the plasmid pTetLuc1 (SEQ ID NO: 1) are used.

Figure 1c shows schematically the production of the luciferase enzyme,

- 15 Figure 2 shows the plasmid pTetLux1 (SEQ ID NO: 3).

Figure 3 shows the plasmid pTetLuc1 (SEQ ID NO: 1).

- 20 Figure 4a shows the production of light (induction factor) versus concentration of tetracycline in samples for three different tetracyclines,

Figure 4b shows the production of light (induction factor) versus concentration of tetracycline in samples for further four different tetracyclines.

- 25 Figure 5 shows the effect of magnesium ions on the sensitivity of the method according to the invention.

Figure 6 illustrates possibilities of changing the assay window for the method of the invention by adjusting magnesium ion concentration and pH.

- Figure 7 shows the induction factor versus tetracycline concentration when using
5 freeze-dried *E. coli* in the determination of tetracycline.

Figure 8 shows a comparison of the assays based on using cells with the plasmid
pTetLuc1 (SEQ ID NO: 1) and with the plasmid pTetLux1 (SEQ ID NO: 3).

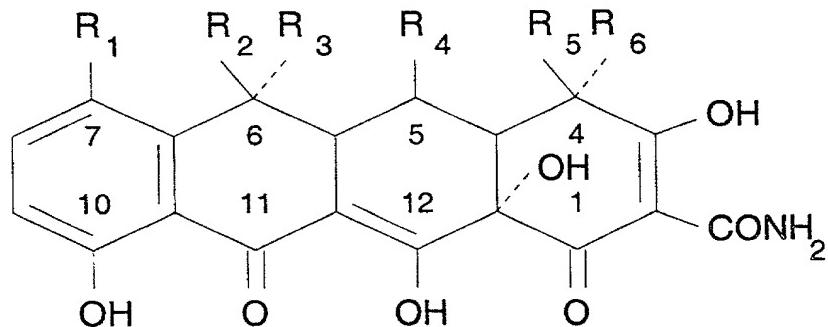
- 10 Figure 9 shows induction factors versus antibiotic concentrations of a pig serum
sample (cells *E. coli* K12, pTetLux1).

- Figure 10 shows the effect of EDTA in a milk sample assay, and
15 Figure 11 shows the light emission versus time for an assay according to the
invention.

DETAILED DESCRIPTION OF THE INVENTION

The term "tetracycline" shall be understood to include any compound covered by the

- 20 general structure formula



and particularly the specific commercially available compounds listed in the table below.

GENERIC NAME	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆
Chlorotetracycline	Cl	OH	CH ₃	H	H	N(CH ₃) ₂
Demethylcholorotetracycline	Cl	OH	H	H	H	N(CH ₃) ₂
Doxycycline	H	H	CH ₃	OH	H	N(CH ₃) ₂
Methacycline	H	CH ₃	H	OH	H	N(CH ₃) ₂
Minocycline	N(CH ₃) ₂	H	H	H	H	N(CH ₃) ₂
Oxytetracycline	H	OH	CH ₃	OH	H	N(CH ₃) ₂
Tetracycline	H	OH	CH ₃	H	H	N(CH ₃) ₂

Furthermore, the term "tetracycline" shall be understood to cover the metabolic and other reformulation/decomposition products thereof.

5

The cells useful in the method of the invention are preferably *Escherichia coli*, which are stored in dried form, e.g. in lyophilized form before their use in the method according to the invention. Also freshly cultivated cells can be used.

- 10 According to a preferred embodiment, the DNA vector including a nucleotide sequence encoding a light producing enzyme is a plasmid containing the luxCDABE genes (SEQ ID NO: 3), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from transposon *Tn*10. Particularly preferable is the plasmid pTetLux1 (SEQ ID NO: 3).

15

According to another preferred embodiment, the DNA vector including a nucleotide sequence encoding a light producing enzyme is a plasmid containing the insect

luciferase gene, tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn*10. In this case the substrate for insect luciferase reaction, D-luciferin, is added to the mixture of the sample and the cells in order to initiate the luminescence of the cells. The plasmid is preferably pTetLuc1
5 (SEQ ID NO: 1).

The method according to this invention is useful for the determination of tetracycline in various kinds of samples. As examples can be mentioned milk, fish, meat, infant formula, eggs, honey, vegetables, serum, plasma, whole blood or the
10 like.

The luminescence of the cells is preferably measured using an X-ray or polaroid film, a CCD-camera (Charge Coupled Device), a liquid scintillation counter or, most preferably, a luminometer.

15 The sensitivity of this analysis method with respect to the tetracycline can be controlled by increasing or decreasing the concentration of divalent metal ions, e.g. magnesium ions, in the mixture of the sample and the cells, by adjusting the pH or by combined adjusting of the divalent metal ion concentration and the pH.
20 Increasing concentration of magnesium ions decreases the sensitivity and vice versa. Increasing pH will also cause a decreasing sensitivity. The sensitivity of the analysis with respect to the tetracycline can be increased by the use of cells which are especially antibiotic sensitive mutant strains. Chelating agents such as EDTA can be added to further sensitize the sensor system for tetracyclines.

25 Figures 1 show a schematic representation of a method based on specific detection of the presence of tetracyclines using microbial cells cloned with either the plasmid pTetLux1 (SEQ ID NO: 3) (Figure 1a) or with the plasmid pTetLuc1 (SEQ ID

NO: 1) (Figure 1b). The figures show that cells containing either of the plasmids can be triggered to produce light by adding a chemical agent (a tetracycline). Light production is a consequence of tetracycline responsive promoter activation due to removal of the tet-repressor protein (SEQ ID NO: 11) leading to the production of 5 luciferase specific mRNA and luciferase protein (SEQ ID NO: 2, 4-8) itself. The principle is demonstrated in Figure 1c. In case of the usage of full length bacterial luciferase operon (SEQ ID NO: 3) containing *luxC*, *luxD*, *luxA*, *luxB* and *luxE* genes (SEQ ID NO: 3) (Figure 1a), one is able to get light emission without addition of any substance. In case of insect (e.g. firefly) luciferase (SEQ ID NO: 2) (Figure 10 1b), light is emitted only after the addition of D-luciferin. It should be noticed that the triggering of luciferase synthesis and light production commences immediately when the cells are introduced to the inducer molecules (tetracyclines). Therefore there is no need to use dividing cells and hence there is no need to use long cultivation of microbial cells such as the case is with conventional methods.

15 Therefore, if needed, one can get results in minutes rather than in hours or days which is the case when conventional methods are used.

Figure 2a shows the plasmid pTetLux1 (SEQ ID NO: 3), in which the production of bacterial luciferase (SEQ ID NO: 4-8) of *Photorhabdus luminescens* (formerly 20 *Xenorhabdus luminescens*; the lux-operon structure and the full-length nucleotide sequence of *P. luminescens* was published in Szittner, R. and Meighen, E. (1990) J. Biol. Chem. 265, 16581-16587) can be switched on by the addition of a chemical agent belonging to the tetracycline family of antimicrobial agents in a cloned *E. coli* bacterium. SEQ ID NO: 3 shows the nucleotide sequence of the plasmid pTetLux1. 25 This plasmid construct is devised to contain the five genes from *P. luminescens* luciferase operon necessary for the light production without any additions of substrates, i.e. cells cloned with such a construct produce substrates endogenously. By incubating *E. coli* cells containing this plasmid (or any other microbial strain

whereto similar regulation/reporter gene system is incorporated containing the necessary secondary regulatory sequences in the constructs such as correct ribosome binding region, transcriptional termination etc.) in the presence of very small amounts of tetracyclines one is able to obtain light production the intensity of which 5 is proportional to the concentration of tetracycline used.

Any *E. coli* mutant strain and especially those strains having a mutation in the export/import machinery of the membranes or otherwise leaky character making it possible for large molecules to easily penetrate inside the cell would be beneficial to 10 use in the method described in this invention. Also other gram-negative bacteria such as strains belonging to genus *Salmonella*, *Shigella*, *Enterobacter*, *Citrobacter*, *Klebsiella*, *Erwinia*, *Pseudomonas*, *Serratia* as well as gram-positive organisms such as those belonging to genus *Bacillus* (especially *B. subtilis*, *B. licheniformis*, *B. pumilus*, *B. globigii*, *B. natto*, *B. amyloliquefaciens* as well as *B. niger*, *B. brevis*, 15 *B. megaterium*), *Streptomyces*, *Lactobacillus* (especially *L. lactis*, *L. casei*) and *Streptococcus* (especially *S. thermophilus*, *S. cremoris*, *S. agalactiae*) come into question. Especially asporogenic strains of *Bacilli* or *Lactobacilli* are suitable.

Figure 3 shows the plasmid pTetLuc1 (SEQ ID NO: 1), in which the production of 20 firefly luciferase (SEQ ID NO: 2) of *Photinus pyralis* (The gene encoding firefly luciferase was originally cloned and sequenced in the middle of the 1980's by DeWet, J. et al. (1987) Mol. Cell. Biol. 7, 725-737) can be switched on by the addition of a chemical agent belonging to the tetracycline family of antimicrobial agents in a cloned *E. coli* bacterium. SEQ ID NO: 1 shows the nucleotide sequence 25 of this plasmid. By incubating *E. coli* cells containing this plasmid (or any other microbial strain whereto similar regulation/reporter gene system is incorporated containing the necessary secondary regulatory sequences in the constructs such as correct ribosome binding region, transcriptional termination etc.) in the presence of

very small amounts of tetracyclines one is able to obtain light production by the addition of D-luciferin, which is the substrate of firefly luciferase. The intensity of light emission is proportional to the concentration of tetracycline used.

- 5 Figures 4a and 4b shows the effect of altogether seven different tetracyclines on the production of light as a function of concentration of each tetracycline. As controls different non-tetracycline antibiotics were included in this study to show that the sensor strain is specific for the tetracyclines. The luminescence was emitted from *E. coli* containing the plasmid pTetLux1 (SEQ ID NO: 3). The detection was made
10 after an incubation of 90 min. All tetracyclines tested behaved in a very similar manner and induction efficiencies were at the same antibiotic concentration area. This makes this sensor even more attractive for analytical use for the determination of the tetracycline group of antibiotics.
- 15 It should be noted that the accumulation of various tetracyclines into microbial cells is very strongly affected by the extracellular concentration of Mg²⁺ ions. Figure 5 shows the effect of increasing concentrations of Mg²⁺ ions on the behavior of *E. coli* cells containing the plasmid pTetLux1 (SEQ ID NO: 3). As can be seen the tetracycline response curve is shifted to the right as a function of increasing
20 concentrations of added Mg²⁺ ions. Thus by increasing the Mg²⁺ ion concentration one is able to decrease the sensitivity of the tetracycline sensor described in this invention. This fact is of great importance in cases where one does not need a high sensitivity of the measurement and where the approximate concentration of the ion is roughly constant and known such as in milk, serum and plasma.

25

The sensitivity can be increased by removing magnesium ions from the assay mixture e.g. by adding a chelating agent forming a complex with magnesium.

Figure 6 shows the possibilities to change the assay window for tetracyclines by adjusting the magnesium ion concentration and by combined adjustment of the magnesium ion concentration and pH.

- 5 The sensitivity of the assay can be increased by the use of cells which are especially antibiotic sensitive mutant strains. Hundreds of specific mutations for bacteria are known with which it is possible to study the activity of specific reactions. For instance trace amounts of antibiotics cause visible changes in the metabolism or in the cell membranes of antibiotic sensitive bacterial mutants. Mutations in cell wall
10 structural components or biosynthetic enzymes as well as in transport and efflux proteins such as porins might have an effect on the behavior of each sensor. Using these kinds of mutations one is able to develop tests measuring residual antibiotics from biological material very sensitively. It is also rather simple to transfer new characteristics into bacterial cells by genetic engineering techniques. This
15 phenomenon broadens the applicability of these organisms in tests utilizing whole cell sensor.

Measurement of light emission can be done by using X-ray or polaroid film, using a liquid scintillation counter, a CCD-camera or a luminometer. The CCD-camera is an
20 instrument which is capable of detecting very low levels of light. In the applications of this invention such kind of a device could be used for the detection of tetracycline residues in food material such as vegetables or meat. The detection of light emission could be directly monitored from the surface of the food material sprayed with engineered luminescent bacteria. Either chemiluminescent (such as peroxidase - luminol) or bioluminescent (such as luciferase - luciferin) reactions can be utilized.
25 The luminometric method is performed with the aid of genes encoding either bacterial or beetle luciferases such as those described in the Figures 2 and 4. Several luminescent bacterial species such as *V. harveyi*, *V. fischeri*, *P. leiognathi*,

P. phosphoreum, *Xenorhabdus luminescens* etc. exist. Luminescent beetles are for example *Luciola mingrellica*, *Photinus pyralis*, *Pyrophorus plagiophthalmus*, *Lampyris noctiluca*, *Pholas dactylus*, etc. Also several eukaryotic species in the sea which luminesce, such as marine ostracod *Vargula hilgendorfii*, jellyfish *Aequorea victoria*, batrachoidid fish *Porichthys notatus*, pempherid fish *Parapriacanthus ransonneti* etc. exist. Fluorescent reporter proteins such as green fluorescent protein (GFP) or any of its variants could be used in the methods described in this invention (Li, X. et al. (1997) J. Biol. Chem. 272, 28545-28549).

- 10 In this invention high detection sensitivity of the luminescent enzyme labels inside a living cell associated with tetracycline-specific induction of label synthesis is based on the use of optimal concentration of all the reactants inside the cell including the necessary cofactors and accessory enzymes. All luciferase genes from these organisms would presumably work in a similar manner as the two examples shown

15 in this invention. These systems together with enhancers and modulators (wavelength, emission kinetics etc.) of light emission has been described in more detail in Campbell, A. "Chemiluminescence; principles and applications in biology and medicine", Weinheim; Deerfield Beach, Fl.; VCH; Chichester: Horwood, 1988.

20 Peroxidases or oxidases can be used together with compounds such as luminol or acridines (for instance lucigenin) to yield luminescent signals suitable for a detection system described here. Enzymatically generated chemiluminescence offers great sensitivity and rapid detection, too, in assays described in this invention. Thermally stable dioxetanes (such as AMPPD and Lumigen PPD) can be

25 enzymatically (such as alkaline phosphatase or β -galactosidase) triggered to produce chemiluminescence (Schaap, A.P. et al. (1989) Clin. Chem. 35, 1863-1864). The only difference to the luciferase enzymes would be that these enzymes are capable

of cleaving a man-made substrate which gives light emission (chemiluminescence) and the luciferases cleave natural substrates to produce light (bioluminescence).

- Tetracycline-controlled expression systems are developed to express heterologous
- 5 proteins in procaryotic and eucaryotic cells for the purpose of production under a tight control of tet-regulatory system (Skerra, A. (1994) Gene 151, 131-135; Gossen, M. and Bujard, H. (1995) US Patent 5,464,758 ; Lutz, R. and Bujard, H. (1997) Nucleic Acids Res. 25, 1203-1210).
- 10 A method to study various tetracyclines and their mode of action was developed by Chopra et al. (Chopra, I. et al. (1990) Antimicrob. Agents Chemother. 34, 111-116) The assay system developed in this study was based on expression of β -galactosidase gene inserted under the control of tetA-gene. The method resulted in less sensitive detection of tetracyclines compared to the invention described here.
- 15 However in order to obtain maximum sensitivities Chopra et al. showed that it was necessary to add cyclic AMP (cAMP) to the medium which is an extremely expensive molecule to be used in routine applications. Furthermore, the method described by Chopra et al. contains a cell disruption stage by sonication in order to assay for the reporter gene activity, β -galactosidase, which step is not practical.
- 20 Instead, the method described in this invention does not contain any cell disruption. The activity of luciferase can be measured directly from living cells in real-time and in the case of pTetLux1 (SEQ ID NO: 3) there is no need of addition of any substrates. Therefore, promoter activation due to the presense/absense of tetracycline can be monitored continuously.

25

EXPERIMENTS

As cloning hosts and in antibiotic residue measurements various *E. coli* MC1061 (*cI+*, *araD139*, Δ (*ara-leu*)7696, *lacX74*, *galU*, *galK*, *hsr*, *hsm*, *strA*) (Casadaban,

M.J. and Cohen, S.N. (1980) J. Mol. Biol. 138, 179-207), BW322 (CGSC, rfa210::Tn10, thi-1, relA1, spoT1, pyrE) and K-12 (M72 Sm^R lacZm-ΔbioavrB, trpEA2, Nam7Nam53cI857 HI) (Remaut, E. et al. (1981) Gene 15, 81-93) can be used. Especially the strain LH530 (Hirvas, L. et al. (1997) Microbiology 143, 73-81) 5 which has a decreased rate of lipid A biosynthesis. It has proven to be hypersusceptible to many different antibiotics.

Cells were grown on appropriate minimal agar-plates and were kept maximally one month at +4 °C after which new plates were stroked. The strains were kept also in 10 15% glycerol at -70 °C, where from growth was started through minimal plates. The cells were first cultivated in 5 ml of 2xTY medium (16 g Bacto tryptone, 8 g Yeast extract, 8 g NaCl, H₂O ad 1 l, pH 7.4, with appropriate antibiotic) 10 h at 30 °C in a shaker after which the cultivation was transferred to a bigger volume for 10 h with same medium.

15

Construction of tetracycline-responsive sensor plasmids:

To construct a recombinant DNA vector carrying luciferase genes under the control of a tetracycline responsive elements two new vectors were created. In the first one modified firefly luciferase gene (SEQ ID NO: 1) from vector pBLuc* (Bonin, A.L. 20 et al. (1994) Gene 141, 75-77) was excised by using restriction enzymes XbaI and HinDIII and the 1.7 kb fragment was isolated from LGT-agarose gel and purified using Qiagen gel extraction kit. This DNA-fragment containing the entire *Photinus pyralis* luciferase gene (SEQ ID NO: 1) was ligated using T4-DNA-ligase enzyme to vector pASK75 (Skerra, A. (1994) Gene 151, 131-135) which was previously 25 restricted with the same restriction enzymes XbaI and HinDIII and calf intestinal phosphatase treated to remove the protruding phosphate groups in order to prevent self-ligation. The resulting ligation mixture was incubated 3 hours at room temperature after which one μl of the mixture was electroporated according to

Dower *et al.* (Dower, W.J. et al. (1988) Nucleic Acids Res. 16, 6126-6144) into electrocompetent *E. coli* MC1061 cells. A plasmid was extracted from one of the colonies obtained and checked for the estimated structure by appropriate restriction enzyme digestions and agarose gel electrophoretic techniques. The plasmid obtained
5 was named as pTetLuc1 (SEQ ID NO: 1).

The plasmid containing the luxCDABE genes (SEQ ID NO: 3) of *Photorhabdus luminescens* under the control of tetracycline responsive element was created as follows: Plasmid pASK75 was cut with restriction enzyme EcoRI and CIP-treated.
10 The linearized plasmid was separated on a LGT-agarose gel electrophoresis and the agarose was removed by using the Qiagen kit. The lux operon was excised with EcoRI from plasmid pCGLS-11 (Frackman, S. et al. (1990) J. Bacteriol. 172, 5767-5773), gel purified as above and ligated to pASK75 by using T4-DNA-ligase at 16 °C overnight. The ligation mixture was electroporated into *E. coli* MC1061 cells as
15 described above and correct transformants were screened for their ability to produce light (as measured with a BioOrbit 1250 manual luminometer) which production was increased in the presence of 1 µg/ml of tetracycline-HCl. The plasmid was further verified by restriction enzyme digestions and the correct structure was named as pTetLux1 (SEQ ID NO: 3). All the DNA-manipulations were performed
20 according to Sambrook *et al.*, "Molecular Cloning: A laboratory Manual, Cold Spring Harbor Laboratory Press: Cold Spring Harbor, NY, 1989.

The vector pASK75 was utilized in the construction of tet-sensor plasmids shown in this invention. The vector pASK75 was originally developed for protein production
25 and purification purposes. It contains a signal sequence for secretion of the recombinant protein into the periplasmic space of *E. coli*. Also a C-terminal fusion between a purification tail, the Strept-tag, was incorporated into the vector to facilitate purification of recombinant protein using streptavidin affinity agarose gel

chromatography. The element controlling recombinant gene expression in the vector is tetA promoter/operator system that allows efficient regulation of the expression, which in Skerra's paper was described for the production and one-step purification of a murine single-chain antibody fragment. The tetA promoter/operator (SEQ ID NO: 9) is controlled by tetR-repressor (SEQ ID NO: 9) which is produced by the corresponding gene (SEQ ID NO: 9). Some of the above mentioned elements were eliminated from the present plasmids due to unnecessary features with respect to this invention.

10 **Transfer of the tetracycline sensor vectors to the antibiotic sensitive *E. coli* strain:**

Either pTetLux1 (SEQ ID NO: 3) or pTetLuc1 (SEQ ID NO: 1) was transformed into *E. coli* LH530 cells by electroporation as described above. The transformed cells were restreaked on agar plates and kept maximally for 2 weeks at +4 °C after 15 which a new plate was streaked.

Use of the manipulated *E. coli* in tetracycline determination methods:

Example 1

Freeze-dried *E. coli* K-12/pTetLux1 were reconstituted with 1.0 ml of L-broth and 20 bacteria were diluted 1:10 with 25 mM MES buffer in M9 minimal medium, pH 6.0. 190 µl bacterial suspension was added to microtiter plate wells containing 10 µl of tetracycline dilutions. The plate was incubated 90 minutes at 37 °C after which the plate was measured with Labsystems Luminoskan luminometer. As seen from Figure 7 the sensitivity of the assay of tetracycline is very high and comparable to 25 that of fresh cells.

Example 2

Two different types of sensor DNA vector construct were compared. Strains *E. coli* K-12/pTetLux1 and *E. coli* K-12/pTetLuc1 were cultivated in L-broth media until optical density measured at 600 nm (OD600) was 1.5. The cells were diluted 1 to 50
5 with 25 mM MES-buffer in M9 minimal medium, pH 6.0 (Sambrook *et al.*, 1989, Cold Spring Harbor Laboratory, Cold Spring Harbor) and 190 µl was added to microtitration plate wells and 10 µl of sample dilution of tetracycline was added. After a 60 min incubation at 37 °C the light emission was measured using a
Labsystems Luminoskan luminometer. Figure 8 shows the bioluminescence dose
10 response curve as a function of tetracycline added. As seen from the figure both systems (bacterial and insect luciferase) give roughly equal sensitivity of tetracycline detection.

One is able to use different luciferases instead of bacterial luciferase (SEQ ID
15 NO: 4-8) from *P. luminescens* without losing sensitivity or other performance of the test. Figure 8 shows an analogous measurement to the one in Figure 4b. In the plasmid used in this test (pTetLuc1) the bacterial luciferase was compensated with firefly luciferase (SEQ ID NO: 2) as described in Figure 3. The test was done essentially as with bacterial luciferase except that after the cells had been incubated
20 with or without tetracycline 10 minutes at 37 °C the cells were measured for light production after 15 minutes incubation time at 37 °C by adding 100 µl of solution containing 1 mM D-luciferin, in 0.1 M Na-citrate buffer, pH 5.0. Thereafter light production was measured using a manual luminometer 1250 (LKB-Wallac, Turku, Finland). As can be seen from Figure 8 sensitivity of the method to detect
25 tetracycline hydrochloride is extremely high and comparable to the detection made with bacterial luciferase.

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Example 3

A lipemic pig serum was spiked at different concentrations of tetracycline, chlorotetracycline and oxytetracycline. Fresh *E. coli* K-12/pTetLux1 were diluted 1:50 with 25 mM MES buffer in M9 minimal medium, pH 6.0. 100 µl bacterial suspension was added to microtiter plate wells containing 100 µl of pig serum spiked with different tetracyclines. The plate was incubated 90 minutes at 37 °C after which the plate was measured with Labsystems Luminoskan luminometer. As seen from Figure 9 the sensitivity of the assay of different tetracyclines in pig serum matrix is very high.

Example 4

Tetracyclines will form chelate complexes with Ca²⁺ and Mg²⁺ in samples (e.g. milk), and loose their antimicrobial and induction activity in our assay system. Tetracyclines can be displaced from cation chelates by using strong chelating agents such as EDTA. Figure 10 shows the determination of tetracycline from a milk sample, which is spiked with different concentrations of tetracycline. Different amounts of EDTA were added to milk samples and this kind of displacement of cation-tetracycline complex clearly improved the sensitivity of the assay. In the assay we used freeze-dried *E. coli* K12/pTetLux1 that were reconstituted with L-broth 10 minutes in room temperature before the assay.

Example 5

Figure 11 shows the kinetics of bacterial bioluminescence after exposure of *E. coli* K-12/pTetLux1 to different dilutions of tetracycline antibiotics. The specific induction of tetracycline is very fast and specific light emission is seen already at the 10 minutes measuring point in the assay.

It will be appreciated that the methods of the present invention can be incorporated in the form of a variety of embodiments, only a few of which are disclosed herein. It will be apparent for the specialist in the field that other embodiments exist and do not depart from the spirit of the invention. Thus, the described embodiments are illustrative and should not be construed as restrictive.

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SEQUENCE LISTING

(1) GENERAL INFORMATION:

- (i) APPLICANT:
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(F) POSTAL CODE (ZIP): FIN-20100
- (ii) TITLE OF INVENTION: A NEW ASSAY METHOD
- (iii) NUMBER OF SEQUENCES: 11
- (iv) COMPUTER READABLE FORM:
(A) MEDIUM TYPE: Floppy disk
(B) COMPUTER: IBM PC compatible
(C) OPERATING SYSTEM: PC-DOS/MS-DOS
(D) SOFTWARE: PatentIn Release #1.0, Version #1.30 (EPO)
- (vi) PRIOR APPLICATION DATA:
(A) APPLICATION NUMBER: FI 974235
(B) FILING DATE: 14-NOV-1997

(2) INFORMATION FOR SEQ ID NO: 1:

- (i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 4846 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: double
(D) TOPOLOGY: circular
- (ii) MOLECULE TYPE: DNA (genomic)
- (iii) HYPOTHETICAL: NO
- (iv) ANTI-SENSE: NO
- (vi) ORIGINAL SOURCE:
(A) ORGANISM: Photinus pyralis
- (vii) IMMEDIATE SOURCE:
(B) CLONE: pTetLuc1
- (viii) POSITION IN GENOME:
(A) CHROMOSOME SEGMENT: Plasmid

- (ix) FEATURE:
- (A) NAME/KEY: misc_feature
 - (B) LOCATION:1..3098
 - (D) OTHER INFORMATION:/standard_name= "Vector pASK75"
 /note= "Part of plasmid originating from vector pASK75;
 feature description below, SEQ ID 9-11."
 /citation= ([2])
- (ix) FEATURE:
- (A) NAME/KEY: CDS
 - (B) LOCATION:3119..4768
 - (D) OTHER INFORMATION:/product= "Photinus pyralis
 luciferase"
 /citation= ([1])
- (x) PUBLICATION INFORMATION:
- (A) AUTHORS: Bonin,
 - (B) TITLE: Photinus pyralis luciferase: vectors that
 contain a modified luc coding sequence allowing
 convenient transfer into other systems
 - (C) JOURNAL: Gene
 - (D) VOLUME: 141
 - (F) PAGES: 75-77
 - (G) DATE: 1994
 - (K) RELEVANT RESIDUES IN SEQ ID NO: 1: FROM 3099 TO 4772
- (x) PUBLICATION INFORMATION:
- (A) AUTHORS: Skerra, A
 - (B) TITLE: Use of the tetracycline promoter for the
 tightly regulated production of a murine antibody
 fragment in Escherichia coli
 - (C) JOURNAL: Gene
 - (D) VOLUME: 151
 - (E) ISSUE: 1-2
 - (F) PAGES: 131-135
 - (G) DATE: 30-DEC-1994
 - (K) RELEVANT RESIDUES IN SEQ ID NO: 1: FROM 1 TO 3098

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 1:

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CCC GCC GCC GTT GTT TTG GAG CAC GGA AAG ACG ATG ACG GAA AAA Pro Ala Ala Val Val Val Leu Glu His Gly Lys Thr Met Thr Glu Lys 485 490 495	4606
GAG ATC GTG GAT TAC GTC GCC AGT CAA GTA ACA ACC GCC AAA AAG TTG Glu Ile Val Asp Tyr Val Ala Ser Gln Val Thr Thr Ala Lys Lys Leu 500 505 510	4654

CGC GGA GGA GTT GTG TTT GTG GAC GAA GTA CCG AAA GGT CTT ACC GGA Arg Gly Gly Val Val Phe Val Asp Glu Val Pro Lys Gly Leu Thr Gly 515 520 525	4702
AAA CTC GAC GCA AGA AAA ATC AGA GAG ATC CTC ATA AAG GCC AAG AAG Lys Leu Asp Ala Arg Lys Ile Arg Glu Ile Leu Ile Lys Ala Lys Lys 530 535 540	4750
GGC GGA AAG TCC AAA TTG TAAAATGTAA CTGTATTCA CGATGACGAA Gly Gly Lys Ser Lys Leu 545 550	4798
ATTCTTAGCT ATTGTAATAC TCTAGCGGGC TGCAGGAATT CGATATCA	4846

(2) INFORMATION FOR SEQ ID NO: 2:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 550 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear

- (ii) MOLECULE TYPE: protein
- (xi) SEQUENCE DESCRIPTION: SEQ ID NO: 2:

Met Glu Asp Ala Lys Asn Ile Lys Lys Gly Pro Ala Pro Phe Tyr Pro
1 5 10 15

Leu Glu Asp Gly Thr Ala Gly Glu Gln Leu His Lys Ala Met Lys Arg
20 25 30

Tyr Ala Leu Val Pro Gly Thr Ile Ala Phe Thr Asp Ala His Ile Glu
35 40 45

Val Asn Ile Thr Tyr Ala Glu Tyr Phe Glu Met Ser Val Arg Leu Ala
50 55 60

Glu Ala Met Lys Arg Tyr Gly Leu Asn Thr Asn His Arg Ile Val Val
65 70 75 80

Cys Ser Glu Asn Ser Leu Gln Phe Phe Met Pro Val Leu Gly Ala Leu
85 90 95

Phe Ile Gly Val Ala Val Ala Pro Ala Asn Asp Ile Tyr Asn Glu Arg
100 105 110

Glu Leu Leu Asn Ser Met Asn Ile Ser Gln Pro Thr Val Val Phe Val
115 120 125

Ser Lys Lys Gly Leu Gln Lys Ile Leu Asn Val Gln Lys Lys Leu Pro
130 135 140

Ile Ile Gln Lys Ile Ile Met Asp Ser Lys Thr Asp Tyr Gln Gly
145 150 155 160

Phe Gln Ser Met Tyr Thr Phe Val Thr Ser His Leu Pro Pro Gly Phe
165 170 175

Asn Glu Tyr Asp Phe Val Pro Glu Ser Phe Asp Arg Asp Lys Thr Ile
180 185 190

Ala Leu Ile Met Asn Ser Ser Gly Ser Thr Gly Leu Pro Lys Gly Val
195 200 205

Ala Leu Pro His Arg Thr Ala Cys Val Arg Phe Ser His Ala Arg Asp
210 215 220

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Pro Ile Phe Gly Asn Gln Ile Ile Pro Asp Thr Ala Ile Leu Ser Val
 225 230 235 240
 Val Pro Phe His His Gly Phe Gly Met Phe Thr Thr Leu Gly Tyr Leu
 245 250 255
 Ile Cys Gly Phe Arg Val Val Leu Met Tyr Arg Phe Glu Glu Leu
 260 265 270
 Phe Leu Arg Ser Leu Gln Asp Tyr Lys Ile Gln Ser Ala Leu Leu Val
 275 280 285
 Pro Thr Leu Phe Ser Phe Phe Ala Lys Ser Thr Leu Ile Asp Lys Tyr
 290 295 300
 Asp Leu Ser Asn Leu His Glu Ile Ala Ser Gly Gly Ala Pro Leu Ser
 305 310 315 320
 Lys Glu Val Gly Glu Ala Val Ala Lys Arg Phe His Leu Pro Gly Ile
 325 330 335
 Arg Gln Gly Tyr Gly Leu Thr Glu Thr Ser Ala Ile Leu Ile Thr
 340 345 350
 Pro Glu Gly Asp Asp Lys Pro Gly Ala Val Gly Lys Val Val Pro Phe
 355 360 365
 Phe Glu Ala Lys Val Val Asp Leu Asp Thr Gly Lys Thr Leu Gly Val
 370 375 380
 Asn Gln Arg Gly Glu Leu Cys Val Arg Gly Pro Met Ile Met Ser Gly
 385 390 395 400
 Tyr Val Asn Asn Pro Glu Ala Thr Asn Ala Leu Ile Asp Lys Asp Gly
 405 410 415
 Trp Leu His Ser Gly Asp Ile Ala Tyr Trp Asp Glu Asp Glu His Phe
 420 425 430
 Phe Ile Val Asp Arg Leu Lys Ser Leu Ile Lys Tyr Lys Gly Tyr Gln
 435 440 445
 Val Ala Pro Ala Glu Leu Glu Ser Ile Leu Leu Gln His Pro Asn Ile
 450 455 460
 Phe Asp Ala Gly Val Ala Gly Leu Pro Asp Asp Asp Ala Gly Glu Leu
 465 470 475 480
 Pro Ala Ala Val Val Leu Glu His Gly Lys Thr Met Thr Glu Lys
 485 490 495
 Glu Ile Val Asp Tyr Val Ala Ser Gln Val Thr Thr Ala Lys Lys Leu
 500 505 510
 Arg Gly Gly Val Val Phe Val Asp Glu Val Pro Lys Gly Leu Thr Gly
 515 520 525
 Lys Leu Asp Ala Arg Lys Ile Arg Glu Ile Leu Ile Lys Ala Lys Lys
 530 535 540
 Gly Gly Lys Ser Lys Leu
 545 550

(2) INFORMATION FOR SEQ ID NO: 3:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 10220 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: double
 - (D) TOPOLOGY: circular
- (ii) MOLECULE TYPE: DNA (genomic)
- (iii) HYPOTHETICAL: NO
- (iv) ANTI-SENSE: NO
- (vi) ORIGINAL SOURCE:
 - (A) ORGANISM: *Photorhabdus luminescens*
- (vii) IMMEDIATE SOURCE:
 - (B) CLONE: pTetLux1
- (ix) FEATURE:
 - (A) NAME/KEY: misc_feature
 - (B) LOCATION:join(1..3190, 10140..10220)
 - (D) OTHER INFORMATION:/standard_name= "vector pASK75"
/note= "Parts of plasmid originating from vector pASK75;
feature description below, SEQ ID NO: 9-11."
/citation= ([2])
- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION:3634..5082
 - (D) OTHER INFORMATION:/product= "Lux C"
/citation= ([1])
- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION:5097..6017
 - (D) OTHER INFORMATION:/product= "Lux D"
/citation= ([1])
- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION:6069..7148
 - (D) OTHER INFORMATION:/product= "Lux A"
/citation= ([1])
- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION:7166..8146
 - (D) OTHER INFORMATION:/product= "Lux B"
/citation= ([1])
- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION:8256..9437
 - (D) OTHER INFORMATION:/product= "Lux E"
/citation= ([1])
- (x) PUBLICATION INFORMATION:
 - (A) AUTHORS: Frackman,
 - (B) TITLE: Cloning, organization and expression of the
bioluminescence genes of *Xenorhabdus*
luminescens
 - (C) JOURNAL: *J. Bacteriol.*
 - (D) VOLUME: 172
 - (F) PAGES: 5767-5773
 - (G) DATE: 1990
 - (K) RELEVANT RESIDUES IN SEQ ID NO: 3: FROM 3191 TO 10139

(x) PUBLICATION INFORMATION:

- (A) AUTHORS: Skerra, A
 (B) TITLE: Use of the tetracycline promoter for the tightly regulated production of a murine antibody fragment in Escherichia coli
 (C) JOURNAL: Gene
 (D) VOLUME: 151
 (E) ISSUE: 1-2
 (F) PAGES: 131-135
 (G) DATE: 30-DEC-1994
 (K) RELEVANT RESIDUES IN SEQ ID NO: 3: FROM 1 TO 3190

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 3:

AGCTTGACCT	GTGAAGTGAA	AAATGGCGCA	CATTGTGCGA	CATTTTTTTT	GTCTGCCGTT	60
TACCGCTACT	GCGTCACGGA	TCTCCACGCG	CCCTGTAGCG	GCGCATTAAAG	CGCGGCGGGT	120
GTGGTGGTTA	CGCGCAGCGT	GACCGCTACA	CTTGCCAGCG	CCCTAGCGCC	CGCTCCTTTC	180
GCTTTCTTCC	CTTCCTTCT	CGCCACGTTTC	GCCGGCTTTC	CCC GTCAAGC	TCTAAATCGG	240
GGGCTCCCTT	TAGGGTTCCCG	ATTTAGTGCT	TTACGGCACC	TCGACCCCAA	AAAAC TTGAT	300
TAGGGTGTATG	GTTCACGTAG	TGGGCCATCG	CCCTGTATAGA	CGGTTTTTCG	CCCTTTGACG	360
TTGGAGTCCA	CGTTCTTAA	TAGTGGACTC	TTGTTCCAAA	CTGGAACAAC	ACTCAACCCT	420
ATCTCGGTCT	ATTCTTTGA	TTTATAAGGG	ATTTTGCCGA	TTTCCGGCTA	TTGGTTAAAA	480
AATGAGCTGA	TTTAACAAAA	ATTTAACGCG	AATTTAACAA	AAATATTAAC	GCTTACAATT	540
TCAGGGGGCA	CTTTTCGGGG	AAATGTGCGC	GGAACCCCTA	TTTGTATTATT	TTTCTAAATA	600
CATTCAAATA	TGTATCCGCT	CATGAGACAA	TAACCCGTAT	AAATGCTTCA	ATAATATTGA	660
AAAAGGAAGA	GTATGAGTAT	TCAACATTTTC	CGTGTGCCCC	TTATTCCCTT	TTTGCGGGCA	720
TTTTGCCTTC	CTGTTTTGC	TCACCCAGAA	ACGCTGGTGA	AAGTAAAAGA	TGCTGAAGAT	780
CAGTTGGGTG	CACGAGTGGG	TTACATCGAA	CTGGATCTCA	ACAGCGGTAA	GATCCTTGAG	840
AGTTTCGCC	CCGAAGAACG	TTTCCAATG	ATGAGCACTT	TTAAAGTTCT	GCTATGTGGC	900
GCGGTATTAT	CCCGTATTGA	CGCCGGCAA	GAGCAACTCG	GTGCGCCCAT	ACACTATTCT	960
CAGAATGACT	TGGTTGAGTA	CTCACCAAGTC	ACAGAAAAGC	ATCTTACGGA	TGGCATGACA	1020
GTAAGAGAAT	TATGCAGTGC	TGCCATAACC	ATGAGTGATA	ACACTGCGGC	CAACTTACTT	1080
CTGACAAACGA	TCGGAGGACC	GAAGGAGCTA	ACCGCTTTTT	TGCACAAACAT	GGGGGATCAT	1140
GTAACTCGCC	TTGATCGTTG	GGAACCGGAG	CTGAATGAAG	CCATACCAAA	CGACGAGCGT	1200
GACACCACGA	TGCCTGTAGC	AATGGCAACA	ACGTTGCGCA	AACTATTAAC	TGGCGAACTA	1260
CTTACTCTAG	CTTCCC GGCA	ACAATTGATA	GA CTGGATGG	AGGGGGATAA	AGTTGCAGGA	1320
CCACTTCTGC	GCTCGGCCCT	TCCGGCTGGC	TGGTTATTG	CTGATAAAATC	TGGAGCCGGT	1380
GAGCGTGGCT	CTCGCGGTAT	CATTGCAGCA	CTGGGGCCAG	ATGGTAAGCC	CTCCCGTATC	1440
GTAGTTATCT	ACACGACGGG	GAGTCAGGCA	ACTATGGATG	AACGAAATAG	ACAGATCGCT	1500
GAGATAGGTG	CCTCACTGAT	TAAGCATTGG	TAGGAATTAA	TGATGTCTCG	TTTAGATAAA	1560

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AATAAGCGGG CTTTGCTCGA CGCCTTAGCC ATTGAGATGT TAGATAGGCA CCATAACTCAC	1740
TTTTGCCCTT TAGAAGGGGA AAGCTGGCAA GATTTTTAC GTAATAACGC TAAAAGTTT	1800
AGATGTGCTT TACTAAGTCA TCGCGATGGA GCAGAAAGTAC ATTTAGGTAC ACGGCCTACA	1860
GAAAAACAGT ATGAAACTCT CGAAAATCAA TTAGCCTTTT TATGCCAACAGGTTTTCA	1920
CTAGAGAATG CATTATATGC ACTCAGCGCA GTGGGGCATT TTACTTTAGG TTGCGTATTG	1980
GAAGATCAAG ACCATCAAGT CGCTAAAGAA GAAAGGGAAA CACCTACTAC TGATAGTATG	2040
CCGCCATTAT TACGACAAGC TATCGAATTAA TTGATCACC AAGGTGCAGA GCCAGCCTTC	2100
TTATTCGGCC TTGAATTGAT CATATGCCGA TTAGAAAAAC AACTTAAATG TGAAAGTGGG	2160
TCTTAAAAGC AGCATAACCT TTTCCGTGA TGGTAACCTTC ACTAGTTAA AAGGATCTAG	2220
GTGAAGATCC TTTTGATAA TCTCATGACC AAAATCCCTT AACGTGAGTT TTCGTTCCAC	2280
TGAGCGTCAG ACCCCGTAGA AAAGATCAAA GGATCTTCTT GAGATCCTTT TTTCTGCGC	2340
GTAATCTGCT GCTTGCAAAC AAAAAAACCA CCGCTACCAG CGGTGGTTG TTTGCCGGAT	2400
CAAGAGCTAC CAACTCTTT TCCGAAGGTA ACTGGCTTCA GCAGAGCGCA GATACCAAAT	2460
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ACATACCTCG CTCTGCTAAT CCTGTTACCA GTGGCTGCTG CCAGTGGCGA TAAGTCGTGT	2580
CTTACCGGGT TGGACTCAAG ACGATAGTTA CCGGATAAGG CGCAGCGGTC GGGCTGAACG	2640
GGGGGTTCGT GCACACAGCC CAGCTGGAG CGAACGACCT ACACCGAACT GAGATACCTA	2700
CAGCGTGAGC TATGAGAAAG CGCCACGCTT CCCGAAGGGAA GAAAGGCGGA CAGGTATCCG	2760
GTAAGCGGCAGGTCGGAAAC AGGAGAGCGC ACGAGGGAGC TTCCAGGGGG AAACGCCTGG	2820
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TCGTCAGGGGG GGCGGAGCCT ATGGAAAAAC GCCAGCAACG CGGCCTTTT ACGGTTCCCTG	2940
GCCTTTGCT GGCCTTTGC TCACATGACC CGACACCATC GAATGCCAG ATGATTAATT	3000
CCTAATTTT GTTGACACTC TATCATTGAT AGAGTTATT TACCACTCCC TATCAGTGAT	3060
AGAGAAAAGT GAAATGAATA GTTCGACAAA AATCTAGATA ACGAGGGCAA AAAATGAAA	3120
AGACAGCTAT CGCGATTGCA GTGGCACTGG CTGGTTTCGC TACCGTAGCG CAGGCCTGAG	3180
ACCAGAATTG TTCTTTAGAA ATCTGCCGGT AAAAATTAGA TTGCTATTCA ATCTATTCT	3240
ATCGGTATTG GTGAAATAAT ACTCAGGATA ATAATTACAA TAAATATTAT CACGCATTAG	3300
AGAAGAGCAT GACTTTTTA ATTTAAACTT TTCATTAACA AATCTGTTG ATATGAAAAT	3360
TTTCCTTGC TATTTAACAA GATATTAAGG CGGGAATAGG CGTTATATTG ACGATCCATT	3420
CAGTTAGATT AAAAACCTG AGCAGAAAAT TTATATTATT ATCATAATTAA TGACGAAAGT	3480
TACAGGCCAG GAACCACGTA GTCAGAATCT GATTTCTAT ATATTTGTTA TTTACATCGT	3540
CATAACACAA AAATATAAGA AGCAAGTGTGTT GGTACGACCA GTTCGCAAGA TAGTTAAACA	3600

GCAACTTAAG TTGAAATTAC CCCCATTTAAA TGG ATG GCA AAT ATG ACT AAA AAA Met Ala Asn Met Thr Lys Lys 555	3654
ATT TCA TTC ATT ATT AAC GGC CAG GTT GAA ATC TTT CCC GAA AGT GAT Ile Ser Phe Ile Ile Asn Gly Gln Val Glu Ile Phe Pro Glu Ser Asp 560 565 570	3702
GAT TTA GTG CAA TCC ATT AAT TTT GGT GAT AAT AGT GTT TAC CTG CCA Asp Leu Val Gln Ser Ile Asn Phe Gly Asp Asn Ser Val Tyr Leu Pro 575 580 585	3750
ATA TTG AAT GAC TCT CAT GTA AAA AAC ATT ATT GAT TGT AAT GGA AAT Ile Leu Asn Asp Ser His Val Lys Asn Ile Ile Asp Cys Asn Gly Asn 590 595 600 605	3798
AAC GAA TTA CGG TTG CAT AAC ATT GTC AAT TTT CTC TAT ACG GTA GGG Asn Glu Leu Arg Leu His Asn Ile Val Asn Phe Leu Tyr Thr Val Gly 610 615 620	3846
CAA AGA TGG AAA AAT GAA GAA TAC TCA AGA CGC AGG ACA TAC ATT CGT Gln Arg Trp Lys Asn Glu Glu Tyr Ser Arg Arg Arg Thr Tyr Ile Arg 625 630 635	3894
GAC TTA AAA AAA TAT ATG GGA TAT TCA GAA GAA ATG GCT AAG CTA GAG Asp Leu Lys Lys Tyr Met Gly Tyr Ser Glu Glu Met Ala Lys Leu Glu 640 645 650	3942
GCC AAT TGG ATA TCT ATG ATT TTA TGT TCT AAA GGC GGC CTT TAT GAT Ala Asn Trp Ile Ser Met Ile Leu Cys Ser Lys Gly Gly Leu Tyr Asp 655 660 665	3990
GTT GTA GAA AAT GAA CTT GGT TCT CGC CAT ATC ATG GAT GAA TGG CTA Val Val Glu Asn Glu Leu Gly Ser Arg His Ile Met Asp Glu Trp Leu 670 675 680 685	4038
CCT CAG GAT GAA AGT TAT GTT CGG GCT TTT CCG AAA GGT AAA TCT GTA Pro Gln Asp Glu Ser Tyr Val Arg Ala Phe Pro Lys Gly Lys Ser Val 690 695 700	4086
CAT CTG TTG GCA GGT AAT GTT CCA TTA TCT GGG ATC ATG TCT ATA TTA His Leu Leu Ala Gly Asn Val Pro Leu Ser Gly Ile Met Ser Ile Leu 705 710 715	4134
CGC GCA ATT TTA ACT AAG AAT CAG TGT ATT ATA AAA ACA TCG TCA ACC Arg Ala Ile Leu Thr Lys Asn Gln Cys Ile Ile Lys Thr Ser Ser Thr 720 725 730	4182
GAT CCT TTT ACC GCT AAT GCA TTA GCG TTA AGT TTT ATT GAT GTA GAC Asp Pro Phe Thr Ala Asn Ala Leu Ala Leu Ser Phe Ile Asp Val Asp 735 740 745	4230
CCT AAT CAT CCG ATA ACG CGC TCT TTA TCT GTT ATA TAT TGG CCC CAC Pro Asn His Pro Ile Thr Arg Ser Leu Ser Val Ile Tyr Trp Pro His 750 755 760 765	4278
CAA GGT GAT ACA TCA CTC GCA AAA GAA ATT ATG CGA CAT GCG GAT GTT Gln Gly Asp Thr Ser Leu Ala Lys Glu Ile Met Arg His Ala Asp Val 770 775 780	4326
ATT GTC GCT TGG GGA GGG CCA GAT GCG ATT AAT TGG GCG GTA GAG CAT Ile Val Ala Trp Gly Gly Pro Asp Ala Ile Asn Trp Ala Val Glu His 785 790 795	4374
GCG CCA TCT TAT GCT GAT GTG ATT AAA TTT GGT TCT AAA AAG AGT CTT Ala Pro Ser Tyr Ala Asp Val Ile Lys Phe Gly Ser Lys Lys Ser Leu 800 805 810	4422

TGC ATT ATC GAT AAT CCT GTT GAT TTG ACG TCC GCA GCG ACA GGT GCG Cys Ile Ile Asp Asn Pro Val Asp Leu Thr Ser Ala Ala Thr Gly Ala 815 820 825	4470
GCT CAT GAT GTT TGT TTT TAC GAT CAG CGA GCT TGT TTT TCT GCC CAA Ala His Asp Val Cys Phe Tyr Asp Gln Arg Ala Cys Phe Ser Ala Gln 830 835 840 845	4518
AAC ATA TAT TAC ATG GGA AAT CAT TAT GAG GAA TTT AAG TTA GCG TTG Asn Ile Tyr Tyr Met Gly Asn His Tyr Glu Glu Phe Lys Leu Ala Leu 850 855 860	4566
ATA GAA AAA CTT AAT CTA TAT GCG CAT ATA TTA CCG AAT GCC AAA AAA Ile Glu Lys Leu Asn Leu Tyr Ala His Ile Leu Pro Asn Ala Lys Lys 865 870 875	4614
GAT TTT GAT GAA AAG GCG GCC TAT TCT TTA GTT CAA AAA GAA AGC TTG Asp Phe Asp Glu Lys Ala Ala Tyr Ser Leu Val Gln Lys Glu Ser Leu 880 885 890	4662
TTT GCT GGA TTA AAA GTA GAG GTG GAT ATT CAT CAA CGT TGG ATG ATT Phe Ala Gly Leu Lys Val Glu Val Asp Ile His Gln Arg Trp Met Ile 895 900 905	4710
ATT GAG TCA AAT GCA GGT GTG GAA TTT AAT CAA CCA CTT GGC AGA TGT Ile Glu Ser Asn Ala Gly Val Glu Phe Asn Gln Pro Leu Gly Arg Cys 910 915 920 925	4758
G TG TAC CTT CAT CAC GTC GAT AAT ATT GAG CAA ATA TTG CCT TAT GTT Val Tyr Leu His His Val Asp Asn Ile Glu Gln Ile Leu Pro Tyr Val 930 935 940	4806
CAA AAA AAT AAG ACG CAA ACC ATA TCT ATT TTT CCT TGG GAG TCA TCA Gln Lys Asn Lys Thr Gln Thr Ile Ser Ile Phe Pro Trp Glu Ser Ser 945 950 955	4854
TTT AAA TAT CGA GAT GCG TTA GCA TTA AAA GGT GCG GAA AGG ATT GTA Phe Lys Tyr Arg Asp Ala Leu Ala Leu Lys Gly Ala Glu Arg Ile Val 960 965 970	4902
GAA GCA GGA ATG AAT AAC ATA TTT CGA GTT GGT GGA TCT CAT GAC GGA Glu Ala Gly Met Asn Asn Ile Phe Arg Val Gly Gly Ser His Asp Gly 975 980 985	4950
ATG AGA CCG TTG CAA CGA TTA GTG ACA TAT ATT TCT CAT GAA AGG CCA Met Arg Pro Leu Gln Arg Leu Val Thr Tyr Ile Ser His Glu Arg Pro 990 995 1000 1005	4998
TCT AAC TAT ACG GCT AAG GAT GTT GCG GTT GAA ATA GAA CAG ACT CGA Ser Asn Tyr Thr Ala Lys Asp Val Ala Val Glu Ile Glu Gln Thr Arg 1010 1015 1020	5046
TTC CTG GAA GAA GAT AAG TTC CTT GTA TTT GTC CCA TAATAGGTAA Phe Leu Glu Asp Lys Phe Leu Val Phe Val Pro 1025 1030	5092
AAGT ATG GAA AAT GAA TCA AAA TAT AAA ACC ATC GAC CAC GTT ATT TGT Met Glu Asn Glu Ser Lys Tyr Lys Thr Ile Asp His Val Ile Cys 1 5 10 15	5141
GTT GAA GGA AAT AAA AAA ATT CAT GTT TGG GAA ACG CTG CCA GAA GAA Val Glu Gly Asn Lys Lys Ile His Val Trp Glu Thr Leu Pro Glu Glu 20 25 30	5189
AAC AGC CCA AAG AGA AAG AAT GCC ATT ATT ATT GCG TCT GGT TTT GCC Asn Ser Pro Lys Arg Lys Asn Ala Ile Ile Ala Ser Gly Phe Ala 35 40 45	5237

CGC AGG ATG GAT CAT TTT GCT GGT CTG GCG GAA TAT TTA TCG CGG AAT Arg Arg Met Asp His Phe Ala Gly Leu Ala Glu Tyr Leu Ser Arg Asn 50 55 60	5285
GGA TTT CAT GTG ATC CGC TAT GAT TCG CTT CAC CAC GTT GGA TTG AGT Gly Phe His Val Ile Arg Tyr Asp Ser Leu His His Val Gly Leu Ser 65 70 75	5333
TCA GGG ACA ATT GAT GAA TTT ACA ATG TCT ATA GGA AAG CAG AGC TTG Ser Gly Thr Ile Asp Glu Phe Thr Met Ser Ile Gly Lys Gln Ser Leu 80 85 90 95	5381
TTA GCA GTG GTT GAT TGG TTA ACT ACA CGA AAA ATA AAT AAC TTC GGT Leu Ala Val Val Asp Trp Leu Thr Thr Arg Lys Ile Asn Asn Phe Gly 100 105 110	5429
ATG TTG GCT TCA AGC TTA TCT GCG CGG ATA GCT TAT GCA AGC CTA TCT Met Leu Ala Ser Ser Leu Ser Ala Arg Ile Ala Tyr Ala Ser Leu Ser 115 120 125	5477
GAA ATC AAT GCT TCG TTT TTA ATC ACC GCA GTC GGT GTT GTT AAC TTA Glu Ile Asn Ala Ser Phe Leu Ile Thr Ala Val Gly Val Val Asn Leu 130 135 140	5525
AGA TAT TCT CTT GAA AGA GCT TTA GGG TTT GAT TAT CTC AGT CTA CCC Arg Tyr Ser Leu Glu Arg Ala Leu Gly Phe Asp Tyr Leu Ser Leu Pro 145 150 155	5573
ATT AAT GAA TTG CCG GAT AAT CTA GAT TTT GAA GGC CAT AAA TTG GGT Ile Asn Glu Leu Pro Asp Asn Leu Asp Phe Glu Gly His Lys Leu Gly 160 165 170 175	5621
GCT GAA GTC TTT GCG AGA GAT TGT CTT GAT TTT GGT TGG GAA GAT TTA Ala Glu Val Phe Ala Arg Asp Cys Leu Asp Phe Gly Trp Glu Asp Leu 180 185 190	5669
GCT TCT ACA ATT AAT AAC ATG ATG TAT CTT GAT ATA CCG TTT ATT GCT Ala Ser Thr Ile Asn Asn Met Met Tyr Leu Asp Ile Pro Phe Ile Ala 195 200 205	5717
TTT ACT GCA AAT AAC GAT AAT TGG GTC AAG CAA GAT GAA GTT ATC ACA Phe Thr Ala Asn Asn Asp Asn Trp Val Lys Gln Asp Glu Val Ile Thr 210 215 220	5765
TTG TTA TCA AAT ATT CGT AGT AAT CGA TGC AAG ATA TAT TCT TTG TTA Leu Leu Ser Asn Ile Arg Ser Asn Arg Cys Lys Ile Tyr Ser Leu Leu 225 230 235	5813
GGA AGT TCG CAT GAC TTG AGT GAA AAT TTA GTG GTC CTG CGC AAT TTT Gly Ser Ser His Asp Leu Ser Glu Asn Leu Val Val Leu Arg Asn Phe 240 245 250 255	5861
TAT CAA TCG GTT ACG AAA GCC GCT ATC GCG ATG GAT AAT GAT CAT CTG Tyr Gln Ser Val Thr Lys Ala Ala Ile Ala Met Asp Asn Asp His Leu 260 265 270	5909
GAT ATT GAT GTT GAT ATT ACT GAA CCG TCA TTT GAA CAT TTA ACT ATT Asp Ile Asp Val Asp Ile Thr Glu Pro Ser Phe Glu His Leu Thr Ile 275 280 285	5957
GCG ACA GTC AAT GAA CGC CGA ATG AGA ATT GAG ATT GAA AAT CAA GCA Ala Thr Val Asn Glu Arg Arg Met Arg Ile Glu Ile Glu Asn Gln Ala 290 295 300	6005
ATT TCT CTG TCT TAAAATCTAT TGAGATATTC TATCACTCAA ATAGCAATAT Ile Ser Leu Ser 305	6057

AAGGGACTCTC T ATG AAA TTT GGA AAC TTT TTG CTT ACA TAC CAA CCT CCC Met Lys Phe Gly Asn Phe Leu Leu Thr Tyr Gln Pro Pro 1 5 10	6107
CAA TTT TCT CAA ACA GAG GTA ATG AAA CGT TTG GTT AAA TTA GGT CGC Gln Phe Ser Gln Thr Glu Val Met Lys Arg Leu Val Lys Leu Gly Arg 15 20 25	6155
ATC TCT GAG GAG TGT GGT TTT GAT ACC GTA TGG TTA CTG GAG CAT CAT Ile Ser Glu Glu Cys Gly Phe Asp Thr Val Trp Leu Leu Glu His His 30 35 40 45	6203
TTC ACG GAG TTT GGT TTG CTT GGT AAC CCT TAT GTC GCT GCT GCA TAT Phe Thr Glu Phe Gly Leu Leu Gly Asn Pro Tyr Val Ala Ala Ala Tyr 50 55 60	6251
TTA CTT GGC GCG ACT AAA AAA TTG AAT GTA GGA ACT GCC GCT ATT GTT Leu Leu Gly Ala Thr Lys Lys Leu Asn Val Gly Thr Ala Ala Ile Val 65 70 75	6299
CTT CCC ACA GCC CAT CCA GTA CGC CAA CTT GAA GAT GTG AAT TTA TTG Leu Pro Thr Ala His Pro Val Arg Gln Leu Glu Asp Val Asn Leu Leu 80 85 90	6347
GAT CAA ATG TCA AAA GGA CGA TTT CGG TTT GGT ATT TGC CGA GGG CTT Asp Gln Met Ser Lys Gly Arg Phe Arg Phe Gly Ile Cys Arg Gly Leu 95 100 105	6395
TAC AAC AAG GAC TTT CGC GTA TTC GGC ACA GAT ATG AAT AAC AGT CGC Tyr Asn Lys Asp Phe Arg Val Phe Gly Thr Asp Met Asn Asn Ser Arg 110 115 120 125	6443
GCC TTA GCG GAA TGC TGG TAC GGG CTG ATA AAG AAT GGC ATG ACA GAG Ala Leu Ala Glu Cys Trp Tyr Gly Leu Ile Lys Asn Gly Met Thr Glu 130 135 140	6491
GGA TAT ATG GAA GCT GAT AAT GAA CAT ATC AAG TTC CAT AAG GTA AAA Gly Tyr Met Glu Ala Asp Asn Glu His Ile Lys Phe His Lys Val Lys 145 150 155	6539
GTA AAC CCC GCG GCG TAT AGC AGA GGT GGC GCA CCG GTT TAT GTG GTG Val Asn Pro Ala Ala Tyr Ser Arg Gly Gly Ala Pro Val Tyr Val Val 160 165 170	6587
GCT GAA TCA GCT TCG ACG ACT GAG TGG GCT GCT CAA TTT GGC CTA CCG Ala Glu Ser Ala Ser Thr Thr Glu Trp Ala Ala Gln Phe Gly Leu Pro 175 180 185	6635
ATG ATA TTA AGT TGG ATT ATA AAT ACT AAC GAA AAG AAA GCA CAA CTT Met Ile Leu Ser Trp Ile Ile Asn Thr Asn Glu Lys Lys Ala Gln Leu 190 195 200 205	6683
GAG CTT TAT AAT GAA GTG GCT CAA GAA TAT GGG CAC GAT ATT CAT AAT Glu Leu Tyr Asn Glu Val Ala Gln Glu Tyr Gly His Asp Ile His Asn 210 215 220	6731
ATC GAC CAT TGC TTA TCA TAT ATA ACA TCT GTA GAT CAT GAC TCA ATT Ile Asp His Cys Leu Ser Tyr Ile Thr Ser Val Asp His Asp Ser Ile 225 230 235	6779
AAA GCG AAA GAG ATT TGC CGG AAA TTT CTG GGG CAT TGG TAT GAT TCT Lys Ala Lys Glu Ile Cys Arg Lys Phe Leu Gly His Trp Tyr Asp Ser 240 245 250	6827
TAT GTG AAT GCT ACG ACT ATT TTT GAT GAT TCA GAC CAA ACA AGA GGT Tyr Val Asn Ala Thr Thr Ile Phe Asp Asp Ser Asp Gln Thr Arg Gly 255 260 265	6875

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TAT GAT TTC AAT AAA GGG CAG TGG CGT GAC TTT GTA TTA AAA GGA CAT Tyr Asp Phe Asn Lys Gly Gln Trp Arg Asp Phe Val Leu Lys Gly His 270 275 280 285	6923
AAA GAT ACT AAT CGC CGT ATT GAT TAC AGT TAC GAA ATC AAT CCC GTG Lys Asp Thr Asn Arg Arg Ile Asp Tyr Ser Tyr Glu Ile Asn Pro Val 290 295 300	6971
GGA ACG CCG CAG GAA TGT ATT GAC ATA ATT CAA AAA GAC ATT GAT GCT Gly Thr Pro Gln Glu Cys Ile Asp Ile Ile Gln Lys Asp Ile Asp Ala 305 310 315	7019
ACA GGA ATA TCA AAT ATT TGT TGT GGA TTT GAA GCT AAT GGA ACA GTA Thr Gly Ile Ser Asn Ile Cys Cys Gly Phe Glu Ala Asn Gly Thr Val 320 325 330	7067
GAC GAA ATT ATT GCT TCC ATG AAG CTC TTC CAG TCT GAT GTC ATG CCA Asp Glu Ile Ile Ala Ser Met Lys Leu Phe Gln Ser Asp Val Met Pro 335 340 345	7115
TTT CTT AAA GAA AAA CAA CGT TCG CTA TTA TAT TAGCTAAGGA GAAAGAA Phe Leu Lys Glu Lys Gln Arg Ser Leu Leu Tyr 350 355 360	7165
ATG AAA TTT GGA TTG TTC CTT AAC TTC ATC AAT TCA ACA ACT GTT Met Lys Phe Gly Leu Phe Leu Asn Phe Ile Asn Ser Thr Thr Val 1 5 10 15	7213
CAA GAA CAA AGT ATA GTT CGC ATG CAG GAA ATA ACG GAG TAT GTT GAT Gln Glu Gln Ser Ile Val Arg Met Gln Glu Ile Thr Glu Tyr Val Asp 20 25 30	7261
AAG TTG AAT TTT GAA CAG ATT TTA GTG TAT GAA AAT CAT TTT TCA GAT Lys Leu Asn Phe Glu Gln Ile Leu Val Tyr Glu Asn His Phe Ser Asp 35 40 45	7309
AAT GGT GTT GTC GCC GCT CCT CTG ACT GTT TCT GGT TTT CTG CTC GGT Asn Gly Val Val Gly Ala Pro Leu Thr Val Ser Gly Phe Leu Leu Gly 50 55 60	7357
TTA ACA GAG AAA ATT AAA ATT GGT TCA TTA AAT CAC ATC ATT ACA ACT Leu Thr Glu Lys Ile Lys Ile Gly Ser Leu Asn His Ile Ile Thr Thr 65 70 75 80	7405
CAT CAT CCT GTC GCC ATA GCG GAG GAA GCT TGC TTA TTG GAT CAG TTA His His Pro Val Ala Ile Ala Glu Glu Ala Cys Leu Leu Asp Gln Leu 85 90 95	7453
AGT GAA GGG AGA TTT ATT TTA GGG TTT AGT GAT TGC GAA AAA AAA GAT Ser Glu Gly Arg Phe Ile Leu Gly Phe Ser Asp Cys Glu Lys Lys Asp 100 105 110	7501
GAA ATG CAT TTT TTT AAT CGC CCG GTT GAA TAT CAA CAG CAA CTA TTT Glu Met His Phe Phe Asn Arg Pro Val Glu Tyr Gln Gln Gln Leu Phe 115 120 125	7549
GAA GAG TGT TAT GAA ATC ATT AAC GAT GCT TTA ACA ACA GGC TAT TGT Glu Glu Cys Tyr Glu Ile Ile Asn Asp Ala Leu Thr Thr Gly Tyr Cys 130 135 140	7597
AAT CCA GAT AAC GAT TTT TAT AGC TTC CCT AAA ATA TCT GTA AAT CCC Asn Pro Asp Asn Asp Phe Tyr Ser Phe Pro Lys Ile Ser Val Asn Pro 145 150 155 160	7645
CAT GCT TAT ACG CCA GGC GGA CCT CGG AAA TAT GTA ACA GCA ACC AGT His Ala Tyr Thr Pro Gly Gly Pro Arg Lys Tyr Val Thr Ala Thr Ser 165 170 175	7693

DRAFT DRAFT DRAFT

CAT CAT ATT GTT GAG TGG GCG GCC AAA AAA GGT ATT CCT CTC ATC TTT His His Ile Val Glu Trp Ala Ala Lys Lys Gly Ile Pro Leu Ile Phe 180 185 190	7741
AAG TGG GAT GAT TCT AAT GAT GTT AGA TAT GAA TAT GCT GAA AGA TAT Lys Trp Asp Asp Ser Asn Asp Val Arg Tyr Glu Tyr Ala Glu Arg Tyr 195 200 205	7789
AAA GCC GTT GCG GAT AAA TAT GAC GTT GAC CTA TCA GAG ATA GAC CAT Lys Ala Val Ala Asp Lys Tyr Asp Val Asp Leu Ser Glu Ile Asp His 210 215 220	7837
CAG TTA ATG ATA TTA GTT AAC TAT AAC GAA GAT AGT AAT AAA GCT AAA Gln Leu Met Ile Leu Val Asn Tyr Asn Glu Asp Ser Asn Lys Ala Lys 225 230 235 240	7885
CAA GAG ACG CGT GCA TTT ATT AGT GAT TAT GTT CTT GAA ATG CAC CCT Gln Glu Thr Arg Ala Phe Ile Ser Asp Tyr Val Leu Glu Met His Pro 245 250 255	7933
AAT GAA AAT TTC GAA AAT AAA CTT GAA GAA ATA ATT GCA GAA AAC GCT Asn Glu Asn Phe Glu Asn Lys Leu Glu Glu Ile Ile Ala Glu Asn Ala 260 265 270	7981
GTC GGA AAT TAT ACG GAG TGT ATA ACT GCG GCT AAG TTG GCA ATT GAA Val Gly Asn Tyr Thr Glu Cys Ile Thr Ala Ala Lys Leu Ala Ile Glu 275 280 285	8029
AAG TGT GGT GCG AAA AGT GTA TTG CTG TCC TTT GAA CCA ATG AAT GAT Lys Cys Gly Ala Lys Ser Val Leu Leu Ser Phe Glu Pro Met Asn Asp 290 295 300	8077
TTG ATG AGC CAA AAA AAT GTA ATC AAT ATT GTT GAT GAT AAT ATT AAG Leu Met Ser Gln Lys Asn Val Ile Asn Ile Val Asp Asp Asn Ile Lys 305 310 315 320	8125
AAG TAC CAC ATG GAA TAT ACC TAATAGATTG CGAGTTGCAG CGAGGCCCA Lys Tyr His Met Glu Tyr Thr 325	8176
AGTGAACGAA TCCCCAGGAG CATAGATAAC TATGTGACTG GGGTGAGTGA AAGCAGCCAA	8236
CAAAGCAGCA GCTTGAAAG ATG AAG GGT ATA AAA GAG TAT GAC AGC AGT GCT Met Lys Gly Ile Lys Glu Tyr Asp Ser Ser Ala 1 5 10	8288
GCC ATA CTT TCT AAT ATT ATC TTG AGG AGT AAA ACA GGT ATG ACT TCA Ala Ile Leu Ser Asn Ile Ile Leu Arg Ser Lys Thr Gly Met Thr Ser 15 20 25	8336
TAT GTT GAT AAA CAA GAA ATT ACA GCA AGC TCA GAA ATT GAT GAT TTG Tyr Val Asp Lys Gln Glu Ile Thr Ala Ser Ser Glu Ile Asp Asp Leu 30 35 40	8384
ATT TTT TCG AGC GAT CCA TTA GTG TGG TCT TAC GAC GAG CAG GAA AAA Ile Phe Ser Ser Asp Pro Leu Val Trp Ser Tyr Asp Glu Gln Glu Lys 45 50 55	8432
ATC AGA AAG AAA CTT GTG CTT GAT GCA TTT CGT AAT CAT TAT AAA CAT Ile Arg Lys Lys Leu Val Leu Asp Ala Phe Arg Asn His Tyr Lys His 60 65 70 75	8480
TGT CGA GAA TAT CGT CAC TAC TGT CAG GCA CAC AAA GTA GAT GAC AAT Cys Arg Glu Tyr Arg His Tyr Cys Gln Ala His Lys Val Asp Asp Asn 80 85 90	8528

ATT ACG GAA ATT GAT GAC ATA CCT GTA TTC CCA ACA TCG GTT TTT AAG Ile Thr Glu Ile Asp Asp Ile Pro Val Phe Pro Thr Ser Val Phe Lys 95 100 105	8576
TTT ACT CGC TTA TTA ACT TCT CAG GAA AAC GAG ATT GAA AGT TGG TTT Phe Thr Arg Leu Leu Thr Ser Gln Glu Asn Glu Ile Glu Ser Trp Phe 110 115 120	8624
ACC AGT AGC GGC ACG AAT GGT TTA AAA AGT CAG GTG GCG CGT GAC AGA Thr Ser Ser Gly Thr Asn Gly Leu Lys Ser Gln Val Ala Arg Asp Arg 125 130 135	8672
TTA AGT ATT GAG AGA CTC TTA GGC TCT GTG AGT TAT GCC ATG AAA TAT Leu Ser Ile Glu Arg Leu Leu Gly Ser Val Ser Tyr Gly Met Lys Tyr 140 145 150 155	8720
GTT GGT AGT TGG TTT GAT CAT CAA ATA GAA TTA GTC AAT TTG GGA CCA Val Gly Ser Trp Phe Asp His Gln Ile Glu Leu Val Asn Leu Gly Pro 160 165 170	8768
GAT AGA TTT AAT GCT CAT AAT ATT TGG TTT AAA TAT GTT ATG AGT TTG Asp Arg Phe Asn Ala His Asn Ile Trp Phe Lys Tyr Val Met Ser Leu 175 180 185	8816
GTG GAA TTG TTA TAT CCT ACG ACA TTT ACC GTA ACA GAA GAA CGA ATA Val Glu Leu Leu Tyr Pro Thr Thr Phe Thr Val Thr Glu Glu Arg Ile 190 195 200	8864
GAT TTT GTT AAA ACA TTG AAT AGT CTT GAA CGA ATA AAA AAT CAA GGG Asp Phe Val Lys Thr Leu Asn Ser Leu Glu Arg Ile Lys Asn Gln Gly 205 210 215	8912
AAA GAT CTT TGT CTT ATT GGT TCG CCA TAC TTT ATT TAT TTA CTC TGC Lys Asp Leu Cys Leu Ile Gly Ser Pro Tyr Phe Ile Tyr Leu Leu Cys 220 225 230 235	8960
CAT TAT ATG AAA GAT AAA AAA ATC TCA TTT TCT GGA GAT AAA AGC CTT His Tyr Met Lys Asp Lys Ile Ser Phe Ser Gly Asp Lys Ser Leu 240 245 250	9008
TAT ATC ATA ACC GGA GGC GGC TGG AAA AGT TAC GAA AAA GAA TCT CTG Tyr Ile Ile Thr Gly Gly Trp Lys Ser Tyr Glu Lys Glu Ser Leu 255 260 265	9056
AAA CGT GAT GAT TTC AAT CAT CTT TTA TTT GAT ACT TTC AAT CTC AGT Lys Arg Asp Asp Phe Asn His Leu Leu Phe Asp Thr Phe Asn Leu Ser 270 275 280	9104
GAT ATT AGT CAG ATC CGA GAT ATA TTT AAT CAA GTT GAA CTC AAC ACT Asp Ile Ser Gln Ile Arg Asp Ile Phe Asn Gln Val Glu Leu Asn Thr 285 290 295	9152
TGT TTC TTT GAG GAT GAA ATG CAG CGT AAA CAT GTT CCG CCG TGG GTA Cys Phe Phe Glu Asp Glu Met Gln Arg Lys His Val Pro Pro Trp Val 300 305 310 315	9200
TAT GCG CGA GCG CTT GAT CCT GAA ACG TTG AAA CCT GTA CCT GAT GGA Tyr Ala Arg Ala Leu Asp Pro Glu Thr Leu Lys Pro Val Pro Asp Gly 320 325 330	9248
ACG CCG GGG TTG ATG AGT TAT ATG GAT GCG TCA GCA ACC AGT TAT CCA Thr Pro Gly Leu Met Ser Tyr Met Asp Ala Ser Ala Thr Ser Tyr Pro 335 340 345	9296
GCA TTT ATT GTT ACC GAT GTC GGG ATA ATT AGC AGA GAA TAT GGT Ala Phe Ile Val Thr Asp Asp Val Gly Ile Ile Ser Arg Glu Tyr Gly 350 355 360	9344

AAG TAT CCC GGC GTG CTC GTT GAA ATT TTA CGT CGC GTC AAT ACG AGG Lys Tyr Pro Gly Val Leu Val Glu Ile Leu Arg Arg Val Asn Thr Arg 365 370 375	9392
ACG CAG AAA GGG TGT GCT TTA AGC TTA ACC GAA GCG TTT GAT AGT Thr Gln Lys Gly Cys Ala Leu Ser Leu Thr Glu Ala Phe Asp Ser 380 385 390	9437
TGATATCCTT TGCTTAATTG TAAGTCCAATG GCTTGCGTTA TATAAATCTG AATGACATCT	9497
ACACTTTACA AAATTCTCCA AAACATCCAC ATTTGGGTAC TTGATAGAGG TTTATGGGGT	9557
TGGCTTAACA TTGTTCTCAT TGTTATTATT GGCTCAAAGC AAAAGGAGAT AACATGAAAA	9617
AATTGGCAGT TATGCTTGCA TTGGGAATGA TTAGCTTGG TGCAATGGCA GTTGATGGGT	9677
ATAAAGATGC AAAGTTGGC ATGACAGAAG AAGAGTTCT TTCAAGAGG TTATGTGATT	9737
TTGAAAAATT TGAGGGAGAT TCTCGAATAG AAGAAGTATC ACTTTATTCA TGTTCTGACT	9797
TTTCGTTTGC TAACAAAAG CGTGAAGCAA TGGCATTTTT TTTAAATGGG AAATTAAAAA	9857
GATTAGAGAT TAATATTGGC AGACTTGTGA AGCCAGTAAG CAAATCGTTA ACGAAAAAGT	9917
ACGGAGATGG ATCATCGTAT CCATCAAAAG AAGAATTGGA GAACGCGCTA AAATACAATG	9977
GAACTATGTC TATAGGTTAT GATAATAATA CGGTATTAGT TGATATACAT ATAATATGTG	10037
GCAAAGAAGG CATAGAAACC AGTCAACTGA TTTATACGAG TCCAGATGTT TATACGCTCC	10097
CAGATTCGG AGAAAAAAC CAGGAATTAA AGGGATTAAA GGAATTCGAG CTCGGTACCC	10157
GGGGATCCCT CGAGGTCGAC CTGCAGGCAG CGCTTGGCGT CACCCGCAGT TCGGTGGTTA	10217
ATA	10220

(2) INFORMATION FOR SEQ ID NO: 4:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 483 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 4:

Met Ala Asn Met Thr Lys Lys Ile Ser Phe Ile Ile Asn Gly Gln Val 1 5 10 15
Glu Ile Phe Pro Glu Ser Asp Asp Leu Val Gln Ser Ile Asn Phe Gly 20 25 30
Asp Asn Ser Val Tyr Leu Pro Ile Leu Asn Asp Ser His Val Lys Asn 35 40 45
Ile Ile Asp Cys Asn Gly Asn Asn Glu Leu Arg Leu His Asn Ile Val 50 55 60
Asn Phe Leu Tyr Thr Val Gly Gln Arg Trp Lys Asn Glu Glu Tyr Ser 65 70 75 80
Arg Arg Arg Thr Tyr Ile Arg Asp Leu Lys Lys Tyr Met Gly Tyr Ser 85 90 95
Glu Glu Met Ala Lys Leu Glu Ala Asn Trp Ile Ser Met Ile Leu Cys 100 105 110

Ser Lys Gly Gly Leu Tyr Asp Val Val Glu Asn Glu Leu Gly Ser Arg
 115 120 125
 His Ile Met Asp Glu Trp Leu Pro Gln Asp Glu Ser Tyr Val Arg Ala
 130 135 140
 Phe Pro Lys Gly Lys Ser Val His Leu Leu Ala Gly Asn Val Pro Leu
 145 150 155 160
 Ser Gly Ile Met Ser Ile Leu Arg Ala Ile Leu Thr Lys Asn Gln Cys
 165 170 175
 Ile Ile Lys Thr Ser Ser Thr Asp Pro Phe Thr Ala Asn Ala Leu Ala
 180 185 190
 Leu Ser Phe Ile Asp Val Asp Pro Asn His Pro Ile Thr Arg Ser Leu
 195 200 205
 Ser Val Ile Tyr Trp Pro His Gln Gly Asp Thr Ser Leu Ala Lys Glu
 210 215 220
 Ile Met Arg His Ala Asp Val Ile Val Ala Trp Gly Gly Pro Asp Ala
 225 230 235 240
 Ile Asn Trp Ala Val Glu His Ala Pro Ser Tyr Ala Asp Val Ile Lys
 245 250 255
 Phe Gly Ser Lys Lys Ser Leu Cys Ile Ile Asp Asn Pro Val Asp Leu
 260 265 270
 Thr Ser Ala Ala Thr Gly Ala Ala His Asp Val Cys Phe Tyr Asp Gln
 275 280 285
 Arg Ala Cys Phe Ser Ala Gln Asn Ile Tyr Tyr Met Gly Asn His Tyr
 290 295 300
 Glu Glu Phe Lys Leu Ala Leu Ile Glu Lys Leu Asn Leu Tyr Ala His
 305 310 315 320
 Ile Leu Pro Asn Ala Lys Lys Asp Phe Asp Glu Lys Ala Ala Tyr Ser
 325 330 335
 Leu Val Gln Lys Glu Ser Leu Phe Ala Gly Leu Lys Val Glu Val Asp
 340 345 350
 Ile His Gln Arg Trp Met Ile Ile Glu Ser Asn Ala Gly Val Glu Phe
 355 360 365
 Asn Gln Pro Leu Gly Arg Cys Val Tyr Leu His His Val Asp Asn Ile
 370 375 380
 Glu Gln Ile Leu Pro Tyr Val Gln Lys Asn Lys Thr Gln Thr Ile Ser
 385 390 395 400
 Ile Phe Pro Trp Glu Ser Ser Phe Lys Tyr Arg Asp Ala Leu Ala Leu
 405 410 415
 Lys Gly Ala Glu Arg Ile Val Glu Ala Gly Met Asn Asn Ile Phe Arg
 420 425 430
 Val Gly Gly Ser His Asp Gly Met Arg Pro Leu Gln Arg Leu Val Thr
 435 440 445
 Tyr Ile Ser His Glu Arg Pro Ser Asn Tyr Thr Ala Lys Asp Val Ala
 450 455 460
 Val Glu Ile Glu Gln Thr Arg Phe Leu Glu Asp Lys Phe Leu Val
 465 470 475 480

Phe Val Pro

(2) INFORMATION FOR SEQ ID NO: 5:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 307 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 5:

Met	Glu	Asn	Glu	Ser	Lys	Tyr	Lys	Thr	Ile	Asp	His	Val	Ile	Cys	Val
1									10					15	
Glu Gly Asn Lys Lys Ile His Val Trp Glu Thr Leu Pro Glu Glu Asn															
	20					25							30		
Ser	Pro	Lys	Arg	Lys	Asn	Ala	Ile	Ile	Ile	Ala	Ser	Gly	Phe	Ala	Arg
		35					40					45			
Arg	Met	Asp	His	Phe	Ala	Gly	Leu	Ala	Glu	Tyr	Leu	Ser	Arg	Asn	Gly
	50				55				60						
Phe	His	Val	Ile	Arg	Tyr	Asp	Ser	Leu	His	His	Val	Gly	Leu	Ser	Ser
	65				70				75			80			
Gly	Thr	Ile	Asp	Glu	Phe	Thr	Met	Ser	Ile	Gly	Lys	Gln	Ser	Leu	Leu
		85				90					95				
Ala	Val	Val	Asp	Trp	Leu	Thr	Thr	Arg	Lys	Ile	Asn	Asn	Phe	Gly	Met
	100					105					110				
Leu	Ala	Ser	Ser	Leu	Ser	Ala	Arg	Ile	Ala	Tyr	Ala	Ser	Leu	Ser	Glu
	115				120						125				
Ile	Asn	Ala	Ser	Phe	Leu	Ile	Thr	Ala	Val	Gly	Val	Val	Asn	Leu	Arg
	130					135					140				
Tyr	Ser	Leu	Glu	Arg	Ala	Leu	Gly	Phe	Asp	Tyr	Leu	Ser	Leu	Pro	Ile
	145					150			155			160			
Asn	Glu	Leu	Pro	Asp	Asn	Leu	Asp	Phe	Glu	Gly	His	Lys	Leu	Gly	Ala
	165					170					175				
Glu	Val	Phe	Ala	Arg	Asp	Cys	Leu	Asp	Phe	Gly	Trp	Glu	Asp	Leu	Ala
	180					185					190				
Ser	Thr	Ile	Asn	Asn	Met	Met	Tyr	Leu	Asp	Ile	Pro	Phe	Ile	Ala	Phe
	195					200					205				
Thr	Ala	Asn	Asn	Asp	Asn	Trp	Val	Lys	Gln	Asp	Glu	Val	Ile	Thr	Leu
	210					215					220				
Leu	Ser	Asn	Ile	Arg	Ser	Asn	Arg	Cys	Lys	Ile	Tyr	Ser	Leu	Leu	Gly
	225					230			235			240			
Ser	Ser	His	Asp	Leu	Ser	Glu	Asn	Leu	Val	Val	Leu	Arg	Asn	Phe	Tyr
	245					250					255				
Gln	Ser	Val	Thr	Lys	Ala	Ala	Ile	Ala	Met	Asp	Asn	Asp	His	Leu	Asp
	260					265					270				
Ile	Asp	Val	Asp	Ile	Thr	Glu	Pro	Ser	Phe	Glu	His	Leu	Thr	Ile	Ala
	275					280					285				

Thr Val Asn Glu Arg Arg Met Arg Ile Glu Ile Glu Asn Gln Ala Ile
290 295 300

Ser Leu Ser
305

(2) INFORMATION FOR SEQ ID NO: 6:

- (i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 360 amino acids
(B) TYPE: amino acid
(D) TOPOLOGY: linear

1) MOLECULE TYPE: protein
1) SEQUENCE DESCRIPTION: SEQ ID NO: 6:

Gln Thr Glu Val Met Lys Arg Leu Val Lys Leu Gly Arg Ile Ser Glu
20 25 30

Glu Cys Gly Phe Asp Thr Val Trp Leu Leu Glu His His Phe Thr Glu
35 40 45

Phe Gly Leu Leu Gly Asn Pro Tyr Val Ala Ala Ala Tyr Leu Leu Gly
50 55 60

Ala Thr Lys Lys Leu Asn Val Gly Thr Ala Ala Ile Val Leu Pro Thr
65 70 75 80

Ala His Pro Val Arg Gln Leu Glu Asp Val Asn Leu Leu Asp Gln Met
85 90 95

Ser Lys Gly Arg Phe Arg Phe Gly Ile Cys Arg Gly Leu Tyr Asn Lys
100 105 110

Asp Phe Arg Val Phe Gly Thr Asp Met Asn Asn Ser Arg Ala Leu Ala
115 120 125

Glu Cys Trp Tyr Gly Leu Ile Lys Asn Gly Met Thr Glu Gly Tyr Met
130 135 140

Glu Ala Asp Asn Glu His Ile Lys Phe His Lys Val Lys Val Asn Pro
145 150 155 160

Ala Ala Tyr Ser Arg Gly Gly Ala Pro Val Tyr Val Val Ala Glu Ser
165 170 175

Ala Ser Thr Thr Glu Trp Ala Ala Gln Phe Gly Leu Pro Met Ile Leu
180 185 190

Ser Trp Ile Ile Asn Thr Asn Glu Lys Lys Ala Gln Leu Glu Leu Tyr
195 200 205

Asn Glu Val Ala Gln Glu Tyr Gly His Asp Ile His ASN Ile Asp HIS
210 215 220

Cys Leu Ser Tyr Ile Thr Ser Val Asp His Asp Ser Ile Lys Ala Lys
225 230 235 240

Glu Ile Cys Arg Lys Phe Leu Gly His Trp Tyr Asp Ser Tyr Val Asn
245 250 255

Ala Thr Thr Ile Phe Asp Asp Ser Asp Gln Thr Arg Gly Tyr Asp Phe
260 265 270

Asn Lys Gly Gln Trp Arg Asp Phe Val Leu Lys Gly His Lys Asp Thr
 275 280 285
 Asn Arg Arg Ile Asp Tyr Ser Tyr Glu Ile Asn Pro Val Gly Thr Pro
 290 295 300
 Gln Glu Cys Ile Asp Ile Ile Gln Lys Asp Ile Asp Ala Thr Gly Ile
 305 310 320
 Ser Asn Ile Cys Cys Gly Phe Glu Ala Asn Gly Thr Val Asp Glu Ile
 325 330 335
 Ile Ala Ser Met Lys Leu Phe Gln Ser Asp Val Met Pro Phe Leu Lys
 340 345 350
 Glu Lys Gln Arg Ser Leu Leu Tyr
 355 360

(2) INFORMATION FOR SEQ ID NO: 7:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 327 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear
- (ii) MOLECULE TYPE: protein
- (xi) SEQUENCE DESCRIPTION: SEQ ID NO: 7:

Met Lys Phe Gly Leu Phe Phe Leu Asn Phe Ile Asn Ser Thr Thr Val
 1 5 10 15
 Gln Glu Gln Ser Ile Val Arg Met Gln Glu Ile Thr Glu Tyr Val Asp
 20 25 30
 Lys Leu Asn Phe Glu Gln Ile Leu Val Tyr Glu Asn His Phe Ser Asp
 35 40 45
 Asn Gly Val Val Gly Ala Pro Leu Thr Val Ser Gly Phe Leu Leu Gly
 50 55 60
 Leu Thr Glu Lys Ile Lys Ile Gly Ser Leu Asn His Ile Ile Thr Thr
 65 70 75 80
 His His Pro Val Ala Ile Ala Glu Glu Ala Cys Leu Leu Asp Gln Leu
 85 90 95
 Ser Glu Gly Arg Phe Ile Leu Gly Phe Ser Asp Cys Glu Lys Lys Asp
 100 105 110
 Glu Met His Phe Phe Asn Arg Pro Val Glu Tyr Gln Gln Leu Phe
 115 120 125
 Glu Glu Cys Tyr Glu Ile Ile Asn Asp Ala Leu Thr Thr Gly Tyr Cys
 130 135 140
 Asn Pro Asp Asn Asp Phe Tyr Ser Phe Pro Lys Ile Ser Val Asn Pro
 145 150 155 160
 His Ala Tyr Thr Pro Gly Gly Pro Arg Lys Tyr Val Thr Ala Thr Ser
 165 170 175
 His His Ile Val Glu Trp Ala Ala Lys Lys Gly Ile Pro Leu Ile Phe
 180 185 190
 Lys Trp Asp Asp Ser Asn Asp Val Arg Tyr Glu Tyr Ala Glu Arg Tyr
 195 200 205

Lys Ala Val Ala Asp Lys Tyr Asp Val Asp Leu Ser Glu Ile Asp His
 210 215 220

Gln Leu Met Ile Leu Val Asn Tyr Asn Glu Asp Ser Asn Lys Ala Lys
 225 230 235 240

Gln Glu Thr Arg Ala Phe Ile Ser Asp Tyr Val Leu Glu Met His Pro
 245 250 255

Asn Glu Asn Phe Glu Asn Lys Leu Glu Ile Ile Ala Glu Asn Ala
 260 265 270

Val Gly Asn Tyr Thr Glu Cys Ile Thr Ala Ala Lys Leu Ala Ile Glu
 275 280 285

Lys Cys Gly Ala Lys Ser Val Leu Leu Ser Phe Glu Pro Met Asn Asp
 290 295 300

Leu Met Ser Gln Lys Asn Val Ile Asn Ile Val Asp Asp Asn Ile Lys
 305 310 315 320

Lys Tyr His Met Glu Tyr Thr
 325

(2) INFORMATION FOR SEQ ID NO: 8:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 394 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 8:

Met Lys Gly Ile Lys Glu Tyr Asp Ser Ser Ala Ala Ile Leu Ser Asn
 1 5 10 15

Ile Ile Leu Arg Ser Lys Thr Gly Met Thr Ser Tyr Val Asp Lys Gln
 20 25 30

Glu Ile Thr Ala Ser Ser Glu Ile Asp Asp Leu Ile Phe Ser Ser Asp
 35 40 45

Pro Leu Val Trp Ser Tyr Asp Glu Gln Glu Lys Ile Arg Lys Lys Leu
 50 55 60

Val Leu Asp Ala Phe Arg Asn His Tyr Lys His Cys Arg Glu Tyr Arg
 65 70 75 80

His Tyr Cys Gln Ala His Lys Val Asp Asp Asn Ile Thr Glu Ile Asp
 85 90 95

Asp Ile Pro Val Phe Pro Thr Ser Val Phe Lys Phe Thr Arg Leu Leu
 100 105 110

Thr Ser Gln Glu Asn Glu Ile Glu Ser Trp Phe Thr Ser Ser Gly Thr
 115 120 125

Asn Gly Leu Lys Ser Gln Val Ala Arg Asp Arg Leu Ser Ile Glu Arg
 130 135 140

Leu Leu Gly Ser Val Ser Tyr Gly Met Lys Tyr Val Gly Ser Trp Phe
 145 150 155 160

Asp His Gln Ile Glu Leu Val Asn Leu Gly Pro Asp Arg Phe Asn Ala
 165 170 175

DRAFT Sequence Data

His	Asn	Ile	Trp	Phe	Lys	Tyr	Val	Met	Ser	Leu	Val	Glu	Leu	Leu	Tyr
180							185					190			
Pro	Thr	Thr	Phe	Thr	Val	Thr	Glu	Glu	Arg	Ile	Asp	Phe	Val	Lys	Thr
195					200						205				
Leu	Asn	Ser	Leu	Glu	Arg	Ile	Lys	Asn	Gln	Gly	Lys	Asp	Leu	Cys	Leu
210						215					220				
Ile	Gly	Ser	Pro	Tyr	Phe	Ile	Tyr	Leu	Leu	Cys	His	Tyr	Met	Lys	Asp
225					230				235			240			
Lys	Lys	Ile	Ser	Phe	Ser	Gly	Asp	Lys	Ser	Leu	Tyr	Ile	Ile	Thr	Gly
245								250					255		
Gly	Gly	Trp	Lys	Ser	Tyr	Glu	Lys	Glu	Ser	Leu	Lys	Arg	Asp	Asp	Phe
260								265					270		
Asn	His	Leu	Leu	Phe	Asp	Thr	Phe	Asn	Leu	Ser	Asp	Ile	Ser	Gln	Ile
275							280					285			
Arg	Asp	Ile	Phe	Asn	Gln	Val	Glu	Leu	Asn	Thr	Cys	Phe	Phe	Glu	Asp
290						295					300				
Glu	Met	Gln	Arg	Lys	His	Val	Pro	Pro	Trp	Val	Tyr	Ala	Arg	Ala	Leu
305						310				315				320	
Asp	Pro	Glu	Thr	Leu	Lys	Pro	Val	Pro	Asp	Gly	Thr	Pro	Gly	Leu	Met
									325	330				335	
Ser	Tyr	Met	Asp	Ala	Ser	Ala	Thr	Ser	Tyr	Pro	Ala	Phe	Ile	Val	Thr
								340	345				350		
Asp	Asp	Val	Gly	Ile	Ile	Ser	Arg	Glu	Tyr	Gly	Lys	Tyr	Pro	Gly	Val
								355	360				365		
Leu	Val	Glu	Ile	Leu	Arg	Arg	Val	Asn	Thr	Arg	Thr	Gln	Lys	Gly	Cys
							370	375				380			
Ala	Leu	Ser	Leu	Thr	Glu	Ala	Phe	Asp	Ser						
								385	390						

(2) INFORMATION FOR SEQ ID NO: 9:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 3098 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: double
 - (D) TOPOLOGY: circular
- (ii) MOLECULE TYPE: DNA (genomic)
- (vii) IMMEDIATE SOURCE:
 - (B) CLONE: pASK75
- (viii) POSITION IN GENOME:
 - (A) CHROMOSOME SEGMENT: vector
- (ix) FEATURE:
 - (A) NAME/KEY: promoter
 - (B) LOCATION: 542..672
 - (D) OTHER INFORMATION: /function= "beta-lactamase promoter"
/label= beta-lactamase
/citation= ([1])

(ix) FEATURE:
(A) NAME/KEY: CDS
(B) LOCATION:673..1530
(D) OTHER INFORMATION:/product= "beta-la"
/citation= ([1])

(ix) FEATURE:
(A) NAME/KEY: CDS
(B) LOCATION:1543..2163
(D) OTHER INFORMATION:/product= "tetR"
/citation= ([1])

(ix) FEATURE:
(A) NAME/KEY: misc_feature
(B) LOCATION:2713..2950
(D) OTHER INFORMATION:/function= "ORI"
/label= ORI
/citation= ([1])

(ix) FEATURE:
(A) NAME/KEY: promoter
(B) LOCATION:2976..3073
(D) OTHER INFORMATION:/function= "p tetA promoter"
/citation= ([1])

(x) PUBLICATION INFORMATION:
(A) AUTHORS: Skerra, A
(B) TITLE: Use of the tetracycline promoter for the
tightly regulated production of a murine antibody
fragment in Escherichia coli
(C) JOURNAL: Gene
(D) VOLUME: 151
(E) ISSUE: 1-2
(F) PAGES: 131-135
(G) DATE: 30-DEC-1994
(K) RELEVANT RESIDUES IN SEQ ID NO: 9: FROM 1 TO 3098

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 9:

TTGACCT GTGAAGTGAA AAATGGCGCA CATTGTGCGA CATTCCCCCTT GTCTGCCGTT 60
CGCTACT GCGTCACCGA TCTCCACGCG CCCTGTAGCG GCGCATTAAG CGCGGGCGGGT 120
GTGGTTA CGCGCAGCGT GACCGCTACA CTTGCCAGCG CCCTAGCGCC CGCTCCCTTC 180
TTTCTTCC CTTCCCTTCT CGCCACGTTG GCCGGCTTTC CCCGTCAAGC TCTAAATCGG 240
GCTCCCTT TAGGGTTCCG ATTTAGTGCT TTACGGCACC TCGACCCCAA AAAACTTGAT 300
GGGTGATG GTTCACGTAG TGGGCCATCG CCCTGATAGA CGGTTTTTCG CCCTTGACG 360
GGAGTCCA CGTTCTTAA TAGTGGACTC TTGTTCCAAA CTGGAACAAAC ACTCAACCT 420
CTCGGTCT ATTCTTTGA TTTATAAGGG ATTTTGCCGA TTTCCGGCCTA TTGGTTAAAA 480
TGAGCTGA TTTAACAAA ATTTAACGCG AATTTAAACA AAATATTAAC GCTTACAATT 540
AGGTGGCA CTTTCGGGG AAATGTGCGC GGAACCCCTA TTGTTTATT TTTCTAAATA 600
TTCAAATA TGTATCCGCT CATGAGACAA TAACCCTGAT AAATGCTTCA ATAATATTGA 660
AAGGAAGA GT ATG AGT ATT CAA CAT TTC CGT GTC GCC CTT ATT CCC 708
Met Ser Ile Gln His Phe Arg Val Ala Leu Ile Pro
395 400 405

TTT TTT GCG GCA TTT TGC CTT CCT GTT TTT GCT CAC CCA GAA ACG CTG Phe Phe Ala Ala Phe Cys Leu Pro Val Phe Ala His Pro Glu Thr Leu 410 415 420	756
GTG AAA GTA AAA GAT GCT GAA GAT CAG TTG GGT GCA CGA GTG GGT TAC Val Lys Val Lys Asp Ala Glu Asp Gln Leu Gly Ala Arg Val Gly Tyr 425 430 435	804
ATC GAA CTG GAT CTC AAC AGC GGT AAG ATC CTT GAG AGT TTT CGC CCC Ile Glu Leu Asp Leu Asn Ser Gly Lys Ile Leu Glu Ser Phe Arg Pro 440 445 450	852
GAA GAA CGT TTT CCA ATG ATG AGC ACT TTT AAA GTT CTG CTA TGT GGC Glu Glu Arg Phe Pro Met Met Ser Thr Phe Lys Val Leu Leu Cys Gly 455 460 465 470	900
GCG GTA TTA TCC CGT ATT GAC GCC GGG CAA GAG CAA CTC GGT CGC CGC Ala Val Leu Ser Arg Ile Asp Ala Gly Gln Glu Gln Leu Gly Arg Arg 475 480 485	948
ATA CAC TAT TCT CAG AAT GAC TTG GTT GAG TAC TCA CCA GTC ACA GAA Ile His Tyr Ser Gln Asn Asp Leu Val Glu Tyr Ser Pro Val Thr Glu 490 495 500	996
AAG CAT CTT ACG GAT GGC ATG ACA GTA AGA GAA TTA TGC AGT GCT GCC Lys His Leu Thr Asp Gly Met Thr Val Arg Glu Leu Cys Ser Ala Ala 505 510 515	1044
ATA ACC ATG AGT GAT AAC ACT GCG GCC AAC TTA CTT CTG ACA ACG ATC Ile Thr Met Ser Asp Asn Thr Ala Ala Asn Leu Leu Thr Thr Ile 520 525 530	1092
GGA GGA CCG AAG GAG CTA ACC GCT TTT TTG CAC AAC ATG GGG GAT CAT Gly Gly Pro Lys Glu Leu Thr Ala Phe Leu His Asn Met Gly Asp His 535 540 545 550	1140
GTA ACT CGC CTT GAT CGT TGG GAA CCG GAG CTG AAT GAA GCC ATA CCA Val Thr Arg Leu Asp Arg Trp Glu Pro Glu Leu Asn Glu Ala Ile Pro 555 560 565	1188
AAC GAC GAG CGT GAC ACC ACG ATG CCT GTA GCA ATG GCA ACA ACG TTG Asn Asp Glu Arg Asp Thr Thr Met Pro Val Ala Met Ala Thr Thr Leu 570 575 580	1236
CGC AAA CTA TTA ACT GGC GAA CTA CTT ACT CTA GCT TCC CGG CAA CAA Arg Lys Leu Leu Thr Gly Glu Leu Leu Thr Leu Ala Ser Arg Gln Gln 585 590 595	1284
TTG ATA GAC TGG ATG GAG GCG GAT AAA GTT GCA GGA CCA CTT CTG CGC Leu Ile Asp Trp Met Glu Ala Asp Lys Val Ala Gly Pro Leu Leu Arg 600 605 610	1332
TCG GCC CTT CCG GCT GGC TGG TTT ATT GCT GAT AAA TCT GGA GCC GGT Ser Ala Leu Pro Ala Gly Trp Phe Ile Ala Asp Lys Ser Gly Ala Gly 615 620 625 630	1380
GAG CGT GGC TCT CGC GGT ATC ATT GCA GCA CTG GGG CCA GAT GGT AAG Glu Arg Gly Ser Arg Gly Ile Ile Ala Ala Leu Gly Pro Asp Gly Lys 635 640 645	1428
CCC TCC CGT ATC GTA GTT ATC TAC ACG ACG GGG AGT CAG GCA ACT ATG Pro Ser Arg Ile Val Val Ile Tyr Thr Thr Gly Ser Gln Ala Thr Met 650 655 660	1476
GAT GAA CGA AAT AGA CAG ATC GCT GAG ATA GGT GCC TCA CTG ATT AAG Asp Glu Arg Asn Arg Gln Ile Ala Glu Ile Gly Ala Ser Leu Ile Lys 665 670 675	1524

CAT TGG TAGGAATTAA TG ATG TCT CGT TTA GAT AAA AGT AAA GTG ATT His Trp 680 1 Met Ser Arg Leu Asp Lys Ser Lys Val Ile 10	1572
AAC AGC GCA TTA GAG CTG CTT AAT GAG GTC GGA ATC GAA GGT TTA ACA Asn Ser Ala Leu Glu Leu Leu Asn Glu Val Gly Ile Glu Gly Leu Thr 15 20 25	1620
ACC CGT AAA CTC GCC CAG AAG CTA GGT GTA GAG CAG CCT ACA TTG TAT Thr Arg Lys Leu Ala Gln Lys Leu Gly Val Glu Gln Pro Thr Leu Tyr 30 35 40	1668
TGG CAT GTA AAA AAT AAG CGG GCT TTG CTC GAC GCC TTA GCC ATT GAG Trp His Val Lys Asn Lys Arg Ala Leu Leu Asp Ala Leu Ala Ile Glu 45 50 55	1716
ATG TTA GAT AGG CAC CAT ACT CAC TTT TGC CCT TTA GAA GGG GAA AGC Met Leu Asp Arg His His Thr His Phe Cys Pro Leu Glu Gly Glu Ser 60 65 70	1764
TGG CAA GAT TTT TTA CGT AAT AAC GCT AAA AGT TTT AGA TGT GCT TTA Trp Gln Asp Phe Leu Arg Asn Asn Ala Lys Ser Phe Arg Cys Ala Leu 75 80 85 90	1812
CTA AGT CAT CGC GAT GGA GCA AAA GTC CAT TTA GGT ACA CGG CCT ACA Leu Ser His Arg Asp Gly Ala Lys Val His Leu Gly Thr Arg Pro Thr 95 100 105	1860
GAA AAA CAG TAT GAA ACT CTC GAA AAT CAA TTA GCC TTT TTA TGC CAA Glu Lys Gln Tyr Glu Thr Leu Glu Asn Gln Leu Ala Phe Leu Cys Gln 110 115 120	1908
CAA GGT TTT TCA CTA GAG AAT GCA TTA TAT GCA CTC AGC GCA GTG GGG Gln Gly Phe Ser Leu Glu Asn Ala Leu Tyr Ala Leu Ser Ala Val Gly 125 130 135	1956
CAT TTT ACT TTA GGT TGC GTA TTG GAA GAT CAA GAG CAT CAA GTC GCT His Phe Thr Leu Gly Cys Val Leu Glu Asp Gln Glu His Gln Val Ala 140 145 150	2004
AAA GAA GAA AGG GAA ACA CCT ACT ACT GAT AGT ATG CCG CCA TTA TTA Lys Glu Glu Arg Glu Thr Pro Thr Thr Asp Ser Met Pro Pro Leu Leu 155 160 165 170	2052
CGA CAA GCT ATC GAA TTA TTT GAT CAC CAA GGT GCA GAG CCA GCC TTC Arg Gln Ala Ile Glu Leu Phe Asp His Gln Gly Ala Glu Pro Ala Phe 175 180 185	2100
TTA TTC GGC CTT GAA TTG ATC ATA TGC GGA TTA GAA AAA CAA CTT AAA Leu Phe Gly Leu Glu Leu Ile Ile Cys Gly Leu Glu Lys Gln Leu Lys 190 195 200	2148
TGT GAA AGT GGG TCT TAAAAGCAGC ATAACCTTTT TCCGTGATGG TAACCTCACT Cys Glu Ser Gly Ser 205	2203
AGTTTAAAG GATCTAGGTG AAGATCCTTT TTGATAATCT CATGACCAAA ATCCCTTAAC	2263
GTGAGTTTC GTTCCACTGA GCGTCAGACC CCGTAGAAAA GATCAAAGGA TCTTCTTGAG	2323
ATCCTTTTT TCTGGCGTA ATCTGCTGCT TGCAAACAAA AAAACCACCG CTACCAGCGG	2383
TGGTTTGTGTT GCCGGATCAA GAGCTACCAA CTCTTTTCC GAAGGTAACG GGCTTCAGCA	2443
GAGCGCAGAT ACCAAATACT GTCCTTCTAG TGTAGCCGTA GTTAGGCCAC CACTTCAAGA	2503
ACTCTGTAGC ACCGGCTACA TACCTCGCTC TGCTAACCT GTTACCAAGTG GCTGCTGCCA	2563

GTGGCGATAA	GTCGTGTCTT	ACCGGGTTGG	ACTCAAGACG	ATAGTTACCG	GATAAGGCGC	2623
AGCGGTCGGG	CTGAACGGGG	GGTTCGTGCA	CACAGCCCAG	CTTGGAGCGA	ACGACCTACA	2683
CCGAACTGAG	ATACCTACAG	CGTGAGCTAT	GAGAAAGCGC	CACGCTTCCC	GAAGGGAGAA	2743
AGGC GGACAG	GTATCCGGTA	AGCGGCAGGG	TCGGAACAGG	AGAGCGCACG	AGGGAGCTTC	2803
CAGGGGGAAA	CGCCTGGTAT	CTTTATAGTC	CTGTCGGGTT	TCGCCACCTC	TGACTTGAGC	2863
GTG GATT TTT	GTGATGCTCG	TCAGGGGGGC	GGAGCCTATG	GAAAAACGCC	AGCAACGCGG	2923
CCTTTTACG	GTTCCTGGCC	TTTGCTGGC	CTTTGCTCA	CATGACCCGA	CACCATCGAA	2983
TGGCCAGATG	ATTAATT CCT	AATTTTGTT	GACACTCTAT	CATTGATAGA	GTTATTTAC	3043
CACTCCCTAT	CA GTGATAGA	GAAAAGTGAA	ATGAATAGTT	CGACAAAAAT	CTAGA	3098

(2) INFORMATION FOR SEQ ID NO: 10:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 286 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 10:

Met	Ser	Ile	Gln	His	Phe	Arg	Val	Ala	Leu	Ile	Pro	Phe	Phe	Ala	Ala
1					5					10					15
Phe	Cys	Leu	Pro	Val	Phe	Ala	His	Pro	Glu	Thr	Leu	Val	Lys	Val	Lys
					20				25				30		
Asp	Ala	Glu	Asp	Gln	Leu	Gly	Ala	Arg	Val	Gly	Tyr	Ile	Glu	Leu	Asp
					35			40				45			
Leu	Asn	Ser	Gly	Lys	Ile	Leu	Glu	Ser	Phe	Arg	Pro	Glu	Glu	Arg	Phe
					50			55				60			
Pro	Met	Met	Ser	Thr	Phe	Lys	Val	Leu	Leu	Cys	Gly	Ala	Val	Leu	Ser
					65			70		75			80		
Arg	Ile	Asp	Ala	Gly	Gln	Glu	Gln	Leu	Gly	Arg	Arg	Ile	His	Tyr	Ser
					85			90				95			
Gln	Asn	Asp	Leu	Val	Glu	Tyr	Ser	Pro	Val	Thr	Glu	Lys	His	Leu	Thr
					100				105			110			
Asp	Gly	Met	Thr	Val	Arg	Glu	Leu	Cys	Ser	Ala	Ala	Ile	Thr	Met	Ser
					115			120				125			
Asp	Asn	Thr	Ala	Ala	Asn	Leu	Leu	Thr	Thr	Ile	Gly	Gly	Pro	Lys	
					130			135			140				
Glu	Leu	Thr	Ala	Phe	Leu	His	Asn	Met	Gly	Asp	His	Val	Thr	Arg	Leu
					145			150		155			160		
Asp	Arg	Trp	Glu	Pro	Glu	Leu	Asn	Glu	Ala	Ile	Pro	Asn	Asp	Glu	Arg
					165			170				175			
Asp	Thr	Thr	Met	Pro	Val	Ala	Met	Ala	Thr	Thr	Leu	Arg	Lys	Leu	Leu
					180			185			190				
Thr	Gly	Glu	Leu	Leu	Thr	Leu	Ala	Ser	Arg	Gln	Gln	Leu	Ile	Asp	Trp
					195			200			205				

Met Glu Ala Asp Lys Val Ala Gly Pro Leu Leu Arg Ser Ala Leu Pro
 210 215 220
 Ala Gly Trp Phe Ile Ala Asp Lys Ser Gly Ala Gly Glu Arg Gly Ser
 225 230 235 240
 Arg Gly Ile Ile Ala Ala Leu Gly Pro Asp Gly Lys Pro Ser Arg Ile
 245 250 255
 Val Val Ile Tyr Thr Thr Gly Ser Gln Ala Thr Met Asp Glu Arg Asn
 260 265 270
 Arg Gln Ile Ala Glu Ile Gly Ala Ser Leu Ile Lys His Trp
 275 280 285

(2) INFORMATION FOR SEQ ID NO: 11:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 207 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear

- (ii) MOLECULE TYPE: protein
- (xi) SEQUENCE DESCRIPTION: SEQ ID NO: 11:

Met Ser Arg Leu Asp Lys Ser Lys Val Ile Asn Ser Ala Leu Glu Leu
 1 5 10 15
 Leu Asn Glu Val Gly Ile Glu Gly Leu Thr Thr Arg Lys Leu Ala Gln
 20 25 30
 Lys Leu Gly Val Glu Gln Pro Thr Leu Tyr Trp His Val Lys Asn Lys
 35 40 45
 Arg Ala Leu Leu Asp Ala Leu Ala Ile Glu Met Leu Asp Arg His His
 50 55 60
 Thr His Phe Cys Pro Leu Glu Gly Glu Ser Trp Gln Asp Phe Leu Arg
 65 70 75 80
 Asn Asn Ala Lys Ser Phe Arg Cys Ala Leu Leu Ser His Arg Asp Gly
 85 90 95
 Ala Lys Val His Leu Gly Thr Arg Pro Thr Glu Lys Gln Tyr Glu Thr
 100 105 110
 Leu Glu Asn Gln Leu Ala Phe Leu Cys Gln Gln Gly Phe Ser Leu Glu
 115 120 125
 Asn Ala Leu Tyr Ala Leu Ser Ala Val Gly His Phe Thr Leu Gly Cys
 130 135 140
 Val Leu Glu Asp Gln Glu His Gln Val Ala Lys Glu Glu Arg Glu Thr
 145 150 155 160
 Pro Thr Thr Asp Ser Met Pro Pro Leu Leu Arg Gln Ala Ile Glu Leu
 165 170 175
 Phe Asp His Gln Gly Ala Glu Pro Ala Phe Leu Phe Gly Leu Glu Leu
 180 185 190
 Ile Ile Cys Gly Leu Glu Lys Gln Leu Lys Cys Glu Ser Gly Ser
 195 200 205

01 -12- 1999

CLAIMS

1. A method for the determination of a tetracycline in a sample characterized in that
 - the sample is brought into contact with prokaryotic cells encompassing a DNA vector including a nucleotide sequence encoding a light producing enzyme under transcriptional control of a tetracycline repressor and a tetracycline promoter,
 - detecting the luminescence emitted from the intact cells, and
 - comparing the emitted luminescence to the luminescence emitted from cells in a control containing no tetracycline
 - wherein a detectable luminescence higher than a luminescence of the control indicates the presence of tetracycline in the sample.
2. The method according to claim 1 characterized in that the cells are *Escherichia coli*.
3. The method according to claim 1 or 2 characterized in that the DNA vector is a plasmid containing the luxCDABE genes (SEQ ID NO: 3), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn10*.
4. The method according to claim 3 characterized in that the DNA vector is the plasmid pTetLux1 (SEQ ID NO: 3).
5. The method according to claim 1 or 2 characterized in that
 - the DNA vector is a plasmid containing the insect luciferase gene (SEQ ID NO: 1), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn10*, and that

01 -12- 1999

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- D-luciferin is added to the mixture of the sample and the cells in order to initiate the luminescence of the cells.
6. The method according to claim 5 characterized in that the DNA vector is the plasmid pTetLuc1 (SEQ ID NO: 1).
7. The method according to any of the claims 1 - 6 characterized in that the sensitivity of the analysis with respect to the tetracycline is controlled by
 - increasing or decreasing the concentration of divalent metal ions, e.g. magnesium ions, or
 - adjusting the pH, or
 - combined adjusting of the divalent metal ion concentration and the pH.
8. The method according to any of the claims 1 - 6 characterized in that the sensitivity of the analysis with respect to the tetracycline derivative is increased by the use of cells which are especially antibiotic sensitive mutant strains.
9. The method according to any of the claims 1 - 8 characterized in that the luminescence is measured using an X-ray or polaroid film, a CCD-camera, a liquid scintillation counter or a luminometer.
10. The method according to any of the claims 1 - 9 characterized in that the sample to be analyzed is milk, fish, meat, infant formula, eggs, honey, vegetables, serum, plasma, whole blood or the like.
11. A recombinant prokaryotic cell characterized in that it encompasses a DNA vector including a nucleotide sequence encoding a light producing enzyme,

tetracycline repressor and tetracycline promoter, and that the DNA vector is a plasmid containing the luxCDABE genes (SEQ ID NO: 3), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn10*.

12. The cell according to claim 11 characterized in that it is *Escherichia coli*.
13. The cell according to claim 11 or 12, characterized in that it is in dried form, e.g. in lyophilized form.
14. A plasmid characterized in that it comprises the luxCDABE genes (SEQ ID NO: 3), tetracycline repressor (TetR) (SEQ ID NO: 11) and tetracycline promotor (TetA) (SEQ ID NO: 9) from *Tn10*.
15. A plasmid according to claim 14 characterized in that it is pTetLux1 (SEQ ID NO: 3).

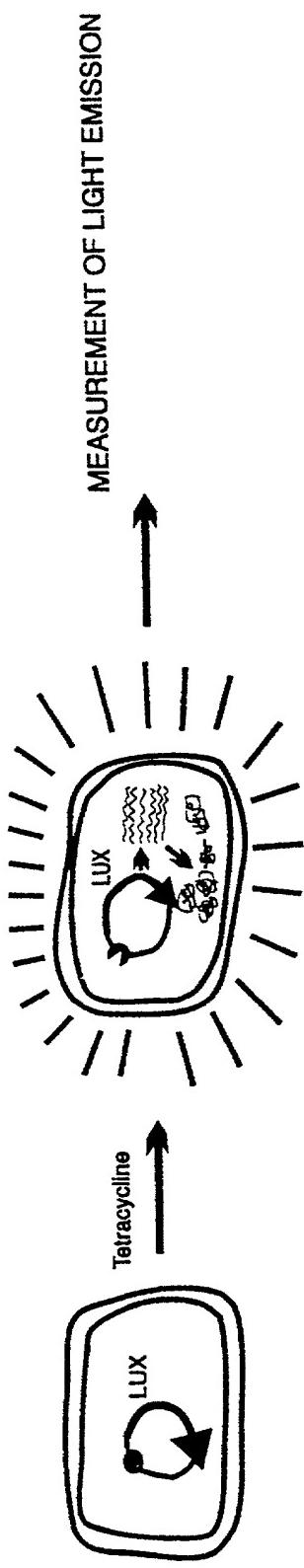


FIG. 1a

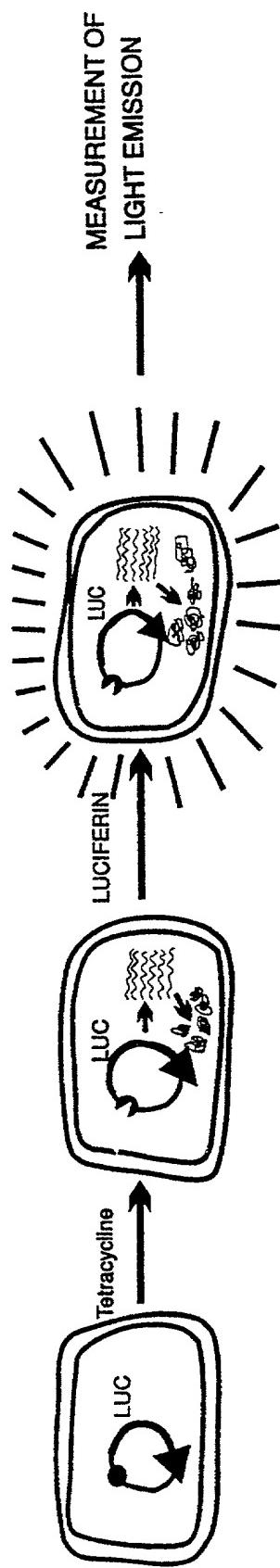
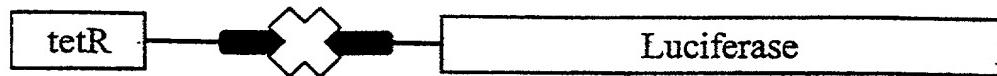


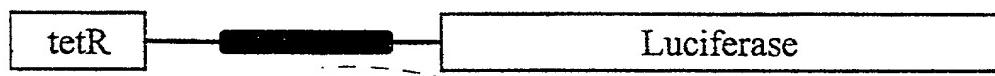
FIG. 1b

A. No Protein Expression

tetR
Bound to tetA

B. Protein Expression

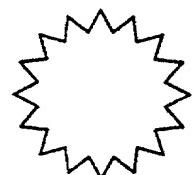
Tetracycline



Luciferase

Tetracycline bound to tetR

FIG. 1c



Luciferase

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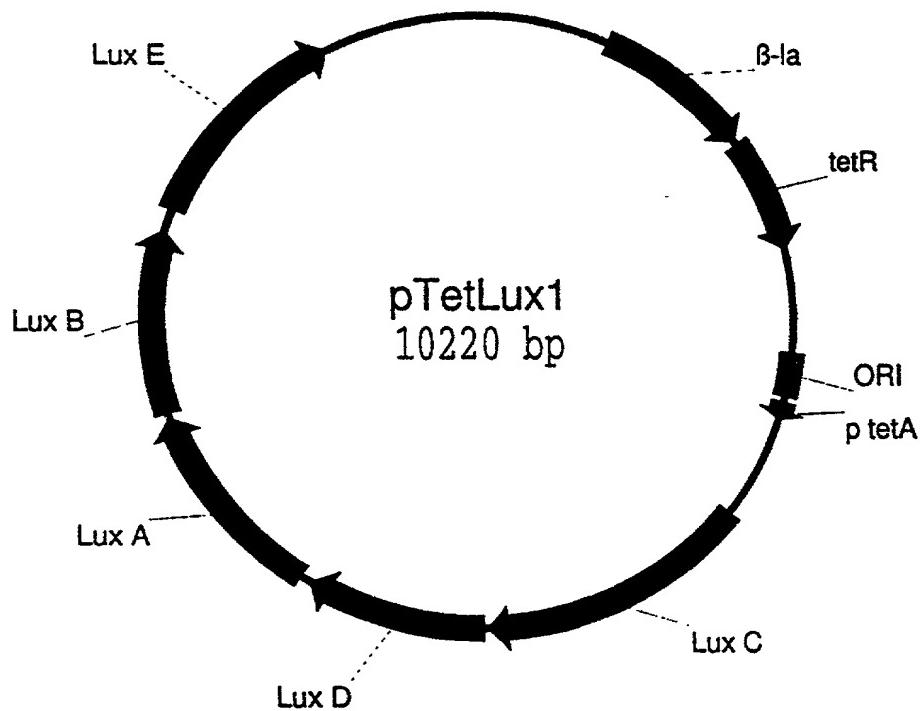


FIG. 2

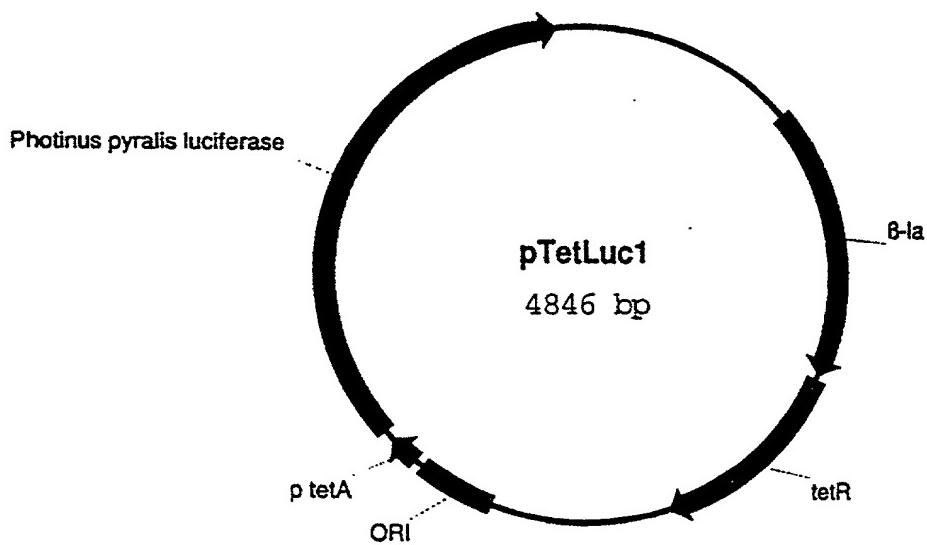


FIG. 3

FIG. 4b

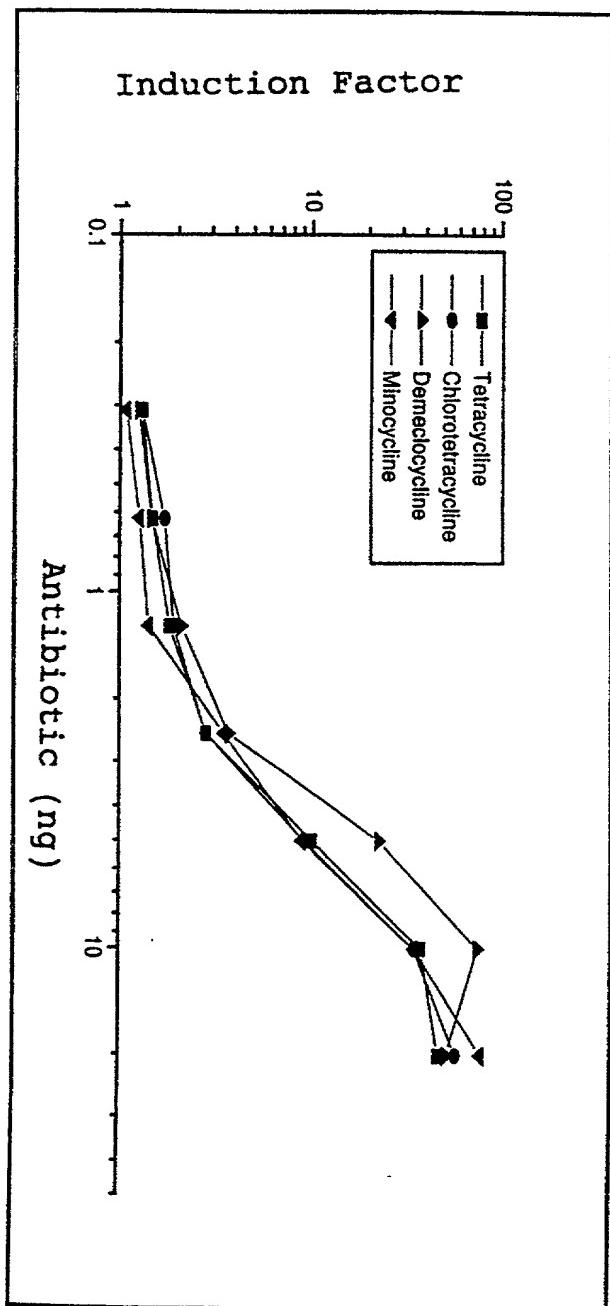
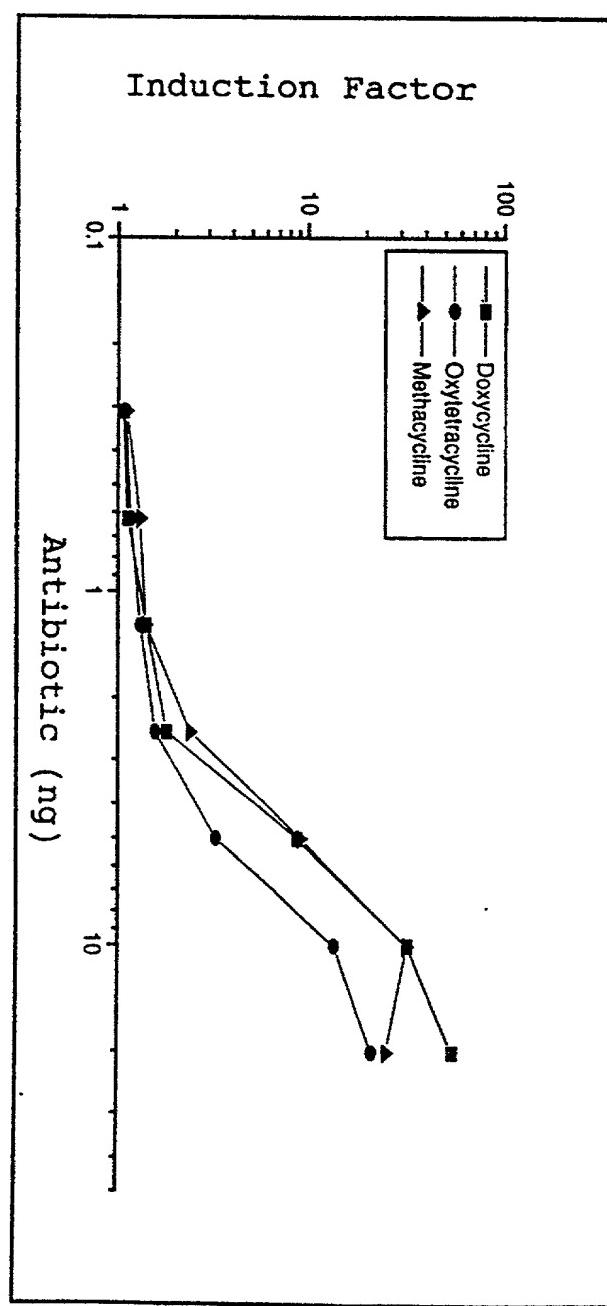


FIG. 4a



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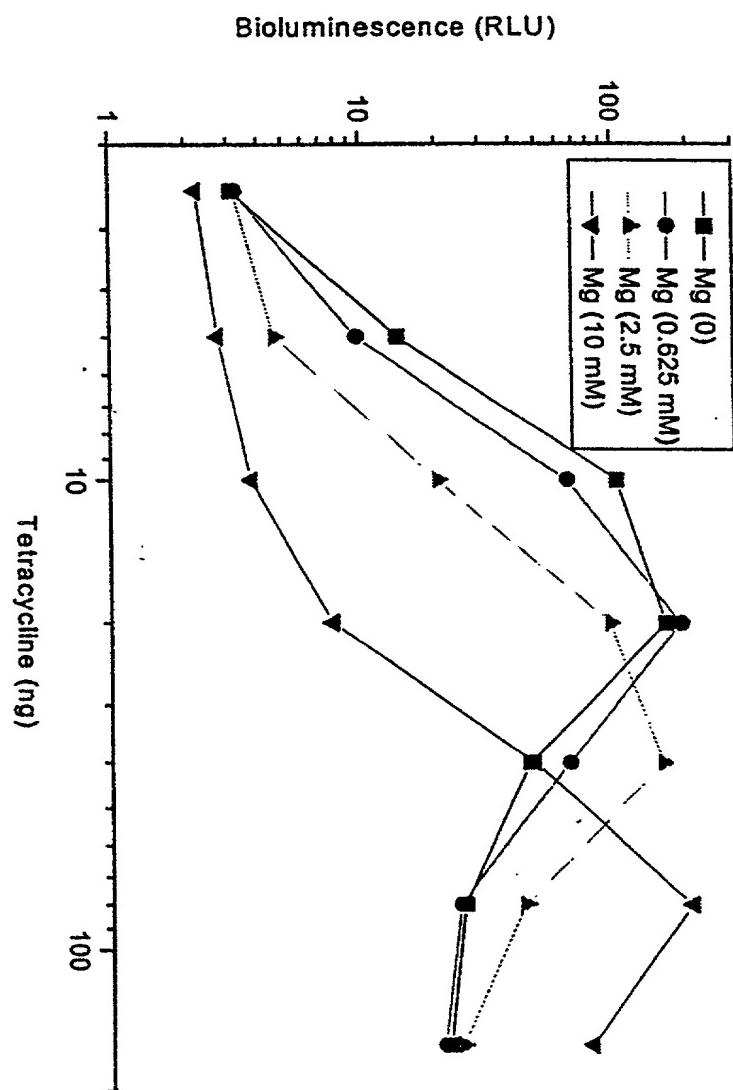


FIG. 5

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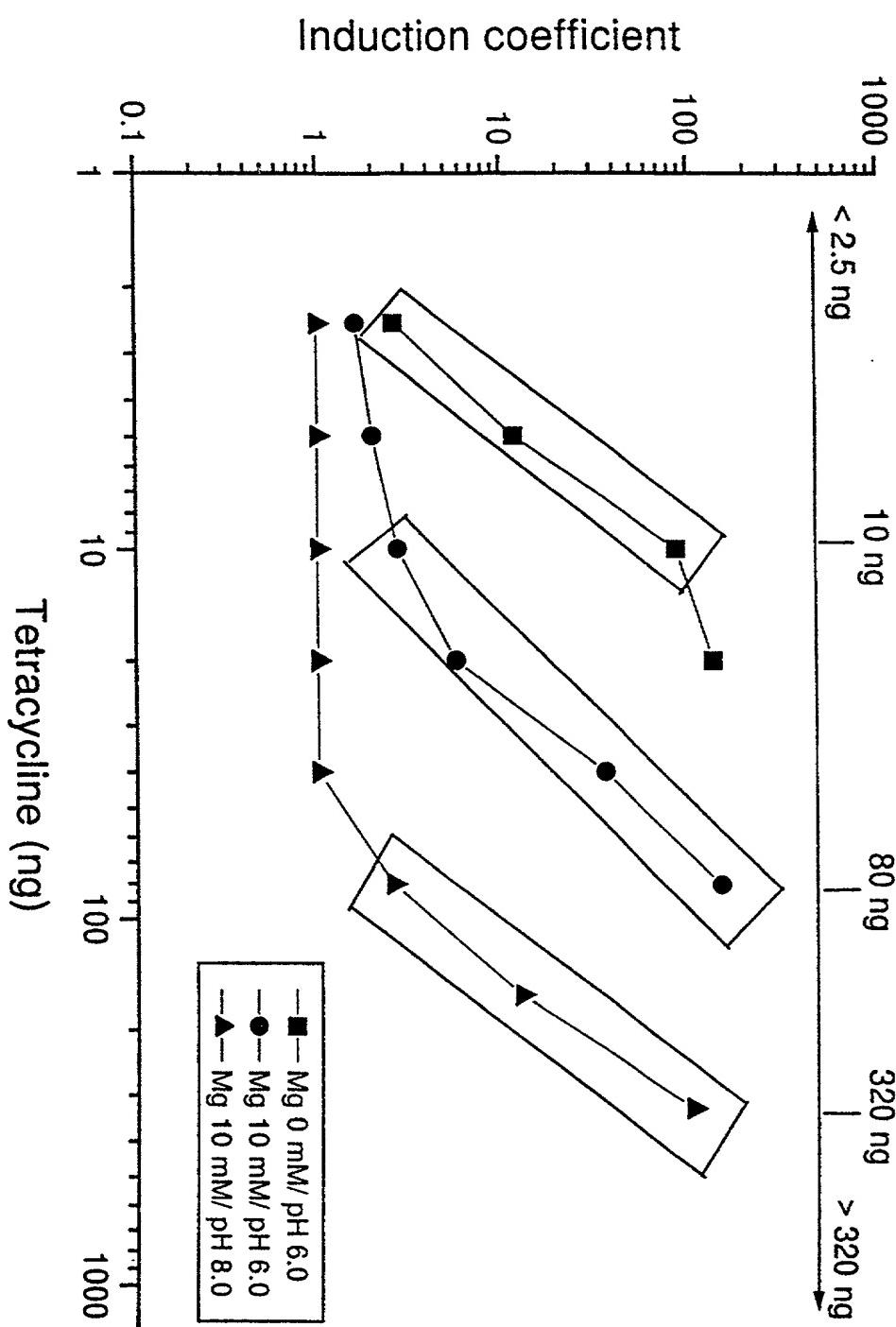


FIG. 6

Tetracycline (ng)

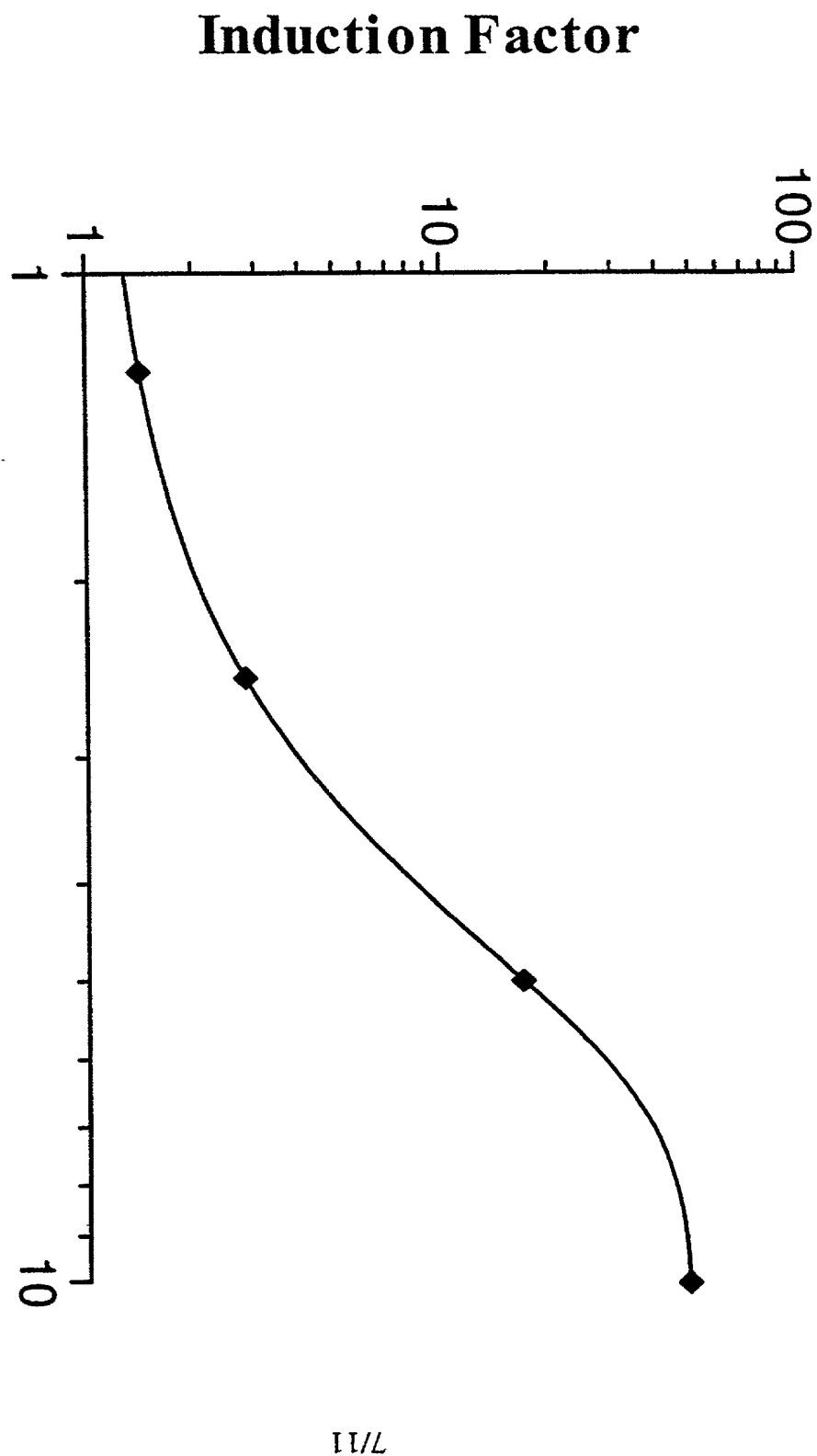
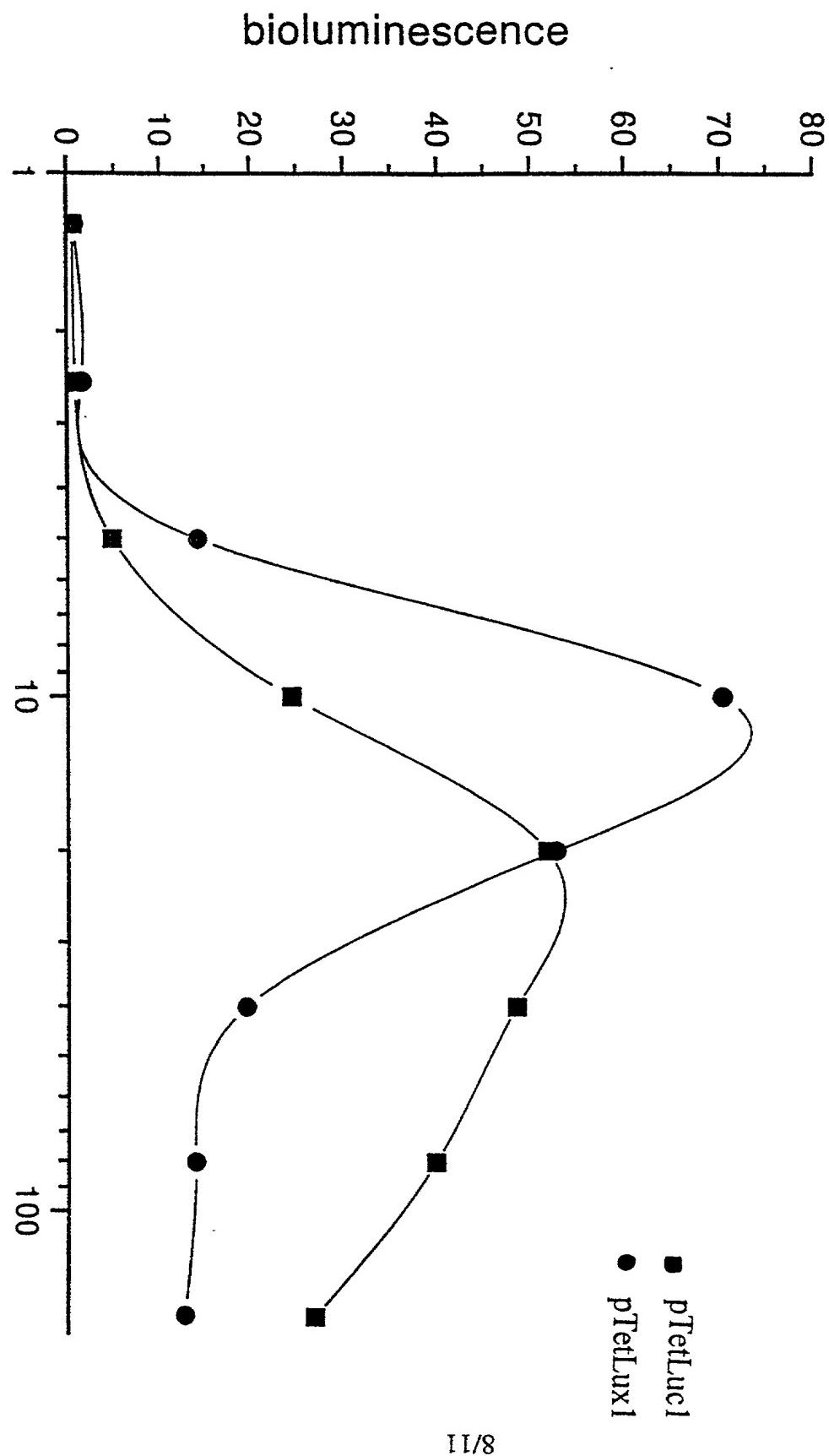


FIG. 7

FIG. 8

tetracycline ng/well



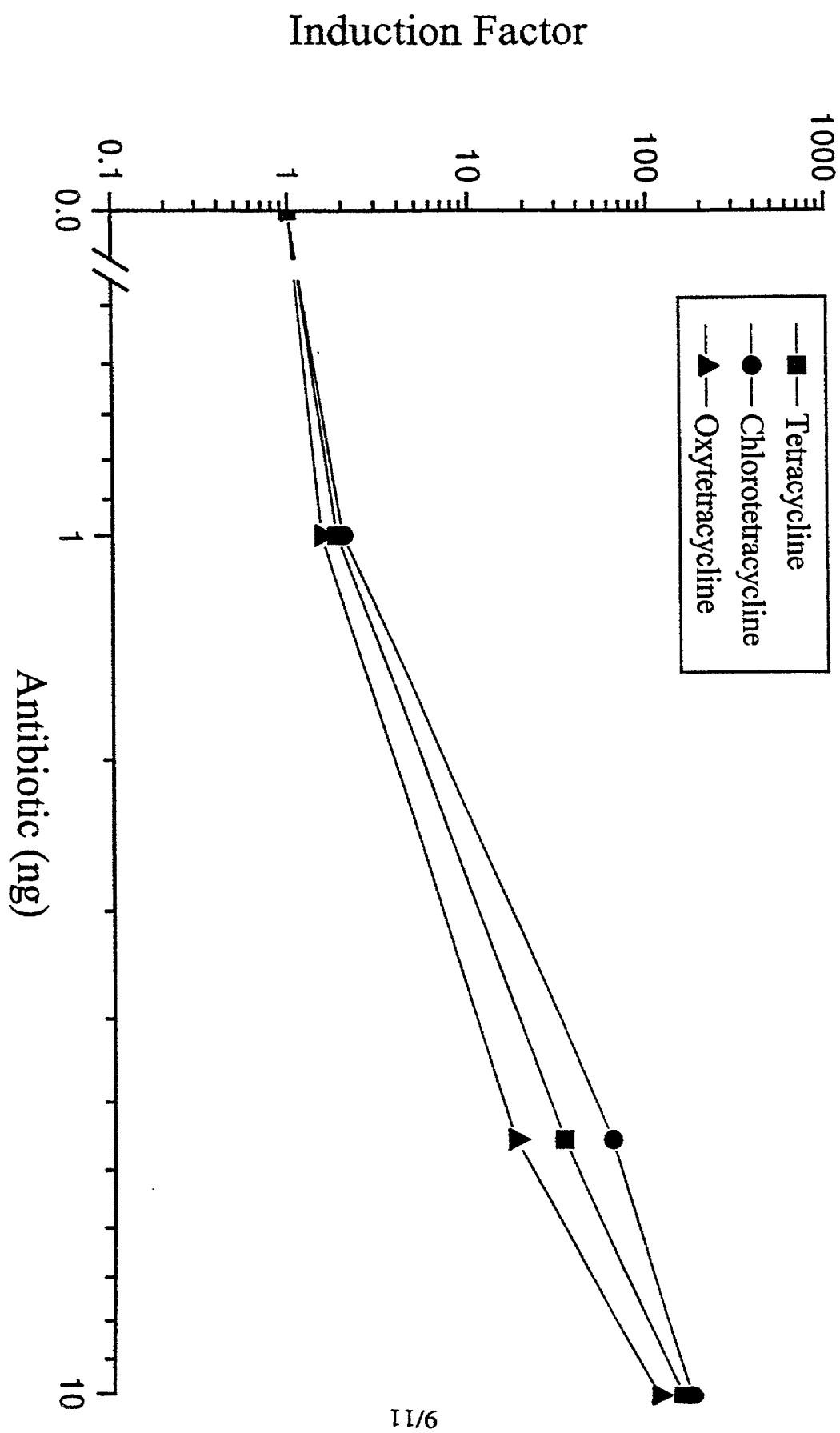


FIG. 9

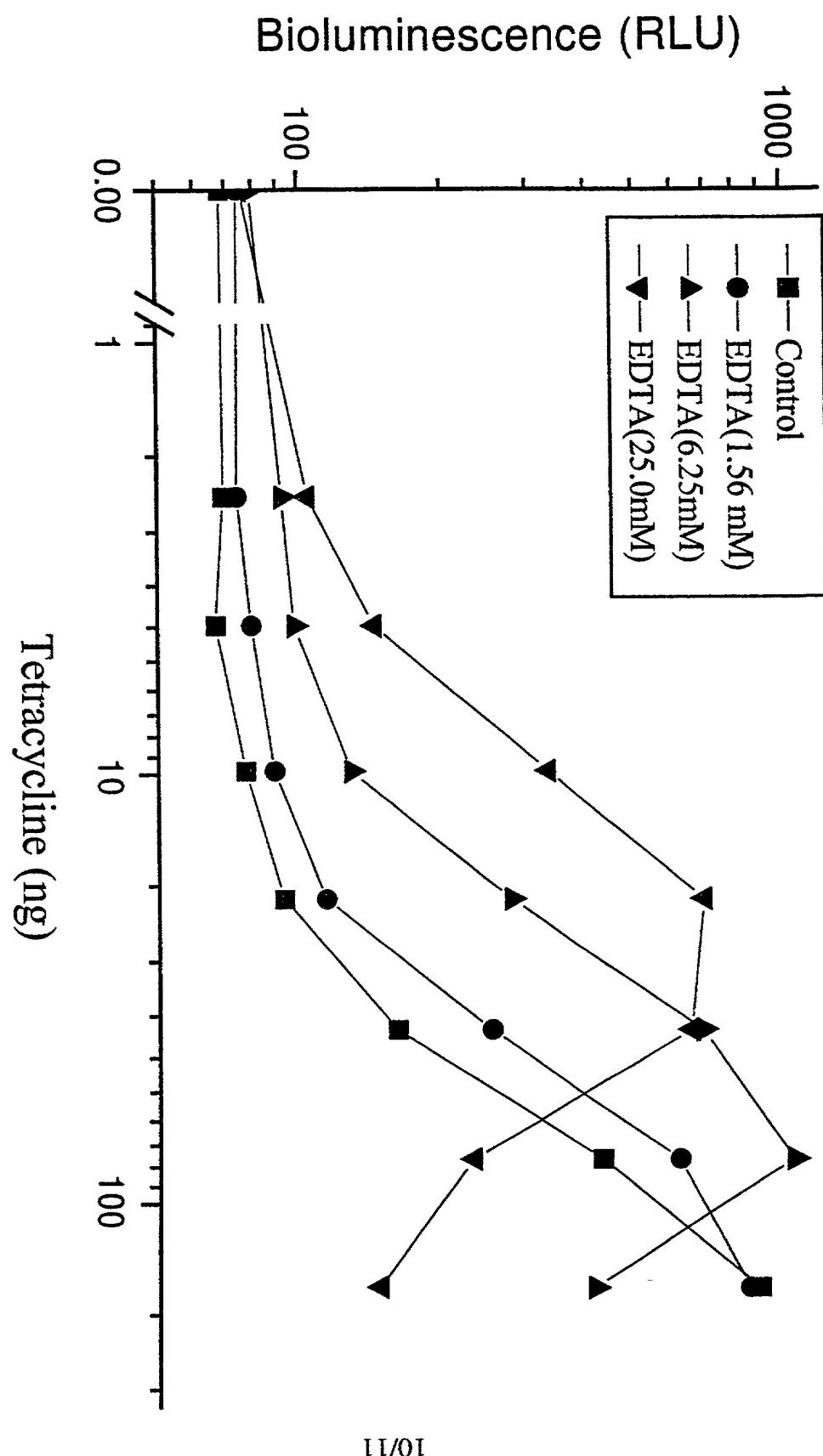


FIG.10

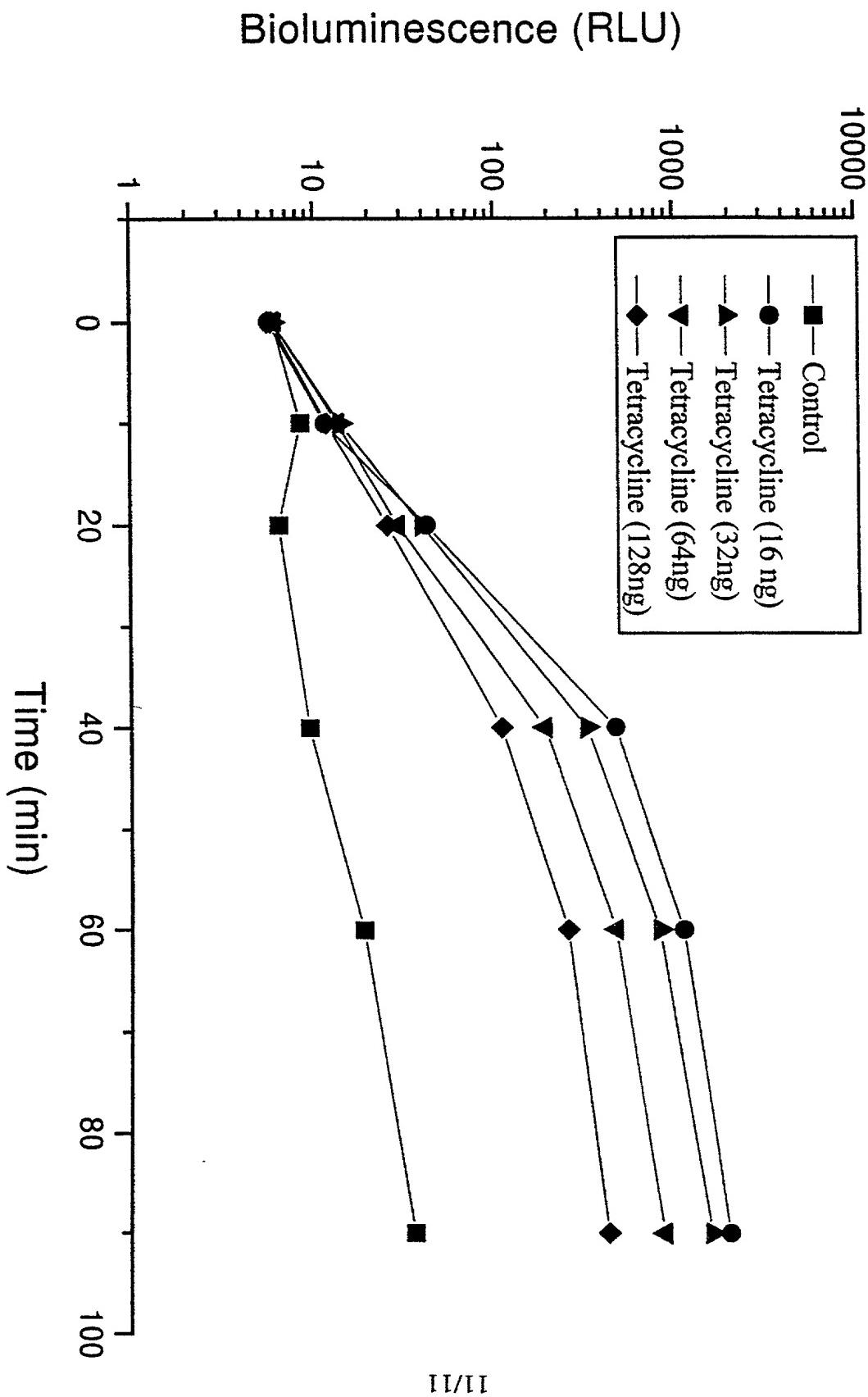


FIG.11

Attorney Docket No. _____

**Declaration and Power of Attorney
For Patent Application
(Sole/Joint)**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought, on the invention entitled "Tetracycline assay method"

the specification of which *(Check One)*

_____ is attached hereto.

was filed on November 11, 1998 as
[] Application Serial No. _____
[X] International Application No. PCT/FI98/00873
and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

Priority Claimed

<u>974235</u> (Number)	<u>Finland</u> (Country)	<u>14/11/1997</u> (Day/Month/Year Filed)	Yes: <input checked="" type="checkbox"/> No: _____
_____	_____	_____	Yes: _____ No: _____
_____	_____	_____	Yes: _____ No: _____

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose

material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.)	(Filing Date)	(Status)

I or we hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to ROTHWELL, FIGG, ERNST & KURZ, P.C., 555 13th Street, N.W., Washington, D.C. 20004

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G. Franklin Rothwell, Reg. No. 18,125	Michael G. Sullivan, Reg. No. 35,377
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Barbara G. Ernst, Reg. No. 30,377	Robert J. Jondle, Reg. No. 33,915
George R. Pepper, Reg. No. 31,414	Moon Soo Lee, Reg. No. 37,377
Bart G. Newland, Reg. No. 31,282	Kenneth M. Fagin, Reg. No. 37,615
Vincent M. DeLuca, Reg. No. 32,408	Stephen B. Parker, Reg. No. 36,631
Celine Jimenez Crowson, Reg. No. 40,357	Michael J. Donnelly, Reg. No. 38,126
Joseph A. Hynds, Reg. No. 34,627	Minaksi Bhatt, Reg. No. 35,447

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full Name of Sole or First Inventor	Inventor's Signature	Date
Matti KORPELA		18.4.2000
Residence		Citizenship
Maijamäentie 13, FIN-21100 Naantali, Finland	FIX	Finnish
Post Office Address	same as residence	
Full Name of Second Joint Inventor, if any	Inventor's Signature	Date
Matti KARP		17.4.2000
Residence		Citizenship
Kampakatu 1, FIN-20660 Littoinen, Finland	FIX	Finnish
Post Office Address	same as residence	
Full Name of Third Joint Inventor, if any	Inventor's Signature	Date
Jussi KURITTU		17.4.2000
Residence		Citizenship
Tuureporinkatu 13 D073, FIN-20300 Turku, Finland	FIX	Finnish
Post Office Address	same as residence	
Full Name of Fourth Joint Inventor, if any	Inventor's Signature	Date
Residence		Citizenship
Post Office Address		